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EXTENDED SAFETY DATA SHEET

JSC “Uralelektromed”

1. IDENTIFICATION OF THE SUBSTANCE\PREPARATION AND OF THE COMPANY\UNDERTAKING

Identification of the substance/preparation	**COPPER SULPHATE**
Product code	EC: 231-847-6, CAS: 7758-99-8
Molecular formula	$CuSO_4 * 5H_2O$
Trade name	Copper sulphate pentahydrate, Grade A
Use of the substance/preparation	-Mineral flotation
Version No.	02/8
Revision date	30-March-2018
SDS Number	PB-00194429-008-2018
Manufacturer/Supplier	JSC “Uralelektromed” 1, Uspensky Avenue, Verkhnyaya Pyshma, 624091 Sverdlovsk region, Russia Tel. +7 34368 47373, +7 34368 46193; fax: +7 34368 46039 Contact person: Natalya Serebryakova Email: snv@elem.ru, oxana@ugmk.com; http: www.elem.ru
Emergency	Emergency phone (Access code): +7 34368 47373
Only representative	Halma Handels GmbH Reichstratsstrasse 11/3 A-1010 Vienna Austria Contact: Dr. Rudolf Kirchmayr Phone: +43 (0) 1 533 56 80 Fax: +43 (0) 1 533 56 80 30 e-mail: Rudolf.kirchmayr@halma.co.at
REACH Registration number	01-2119520566-40-0001

2. HAZARDS IDENTIFICATION

Copper sulphate pentahydrate, > 0.3% nickel sulphate impurity (Harmonised classification and labeling listed in Regulation (EC) No 1272/2008)

Harmonised classification and labeling published in Regulation (EC) No. 1272/2008 is also applicable to hydrated forms of the compound.

Classification

The substance is classified as follows:

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• for physical-chemical properties:	No classification
• for health hazard: - Acute toxicity oral: - Skin corrosion/Irritation: - Serious damage/eye irritation: - Skin sensitization - Reproductive Toxicity: - Carcinogenicity: - STOT - repeated:	Acute Tox. 4 (Hazard statement: H302: Harmful if swallowed.) Skin Irrit. 2 (H315: Causes skin irritation) Eye Irrit. 2 (H319/H318: Causes serious eye irritation/damage) Skin Sens. 1 (H317: May cause an allergic skin reaction.) Repr. 1B (H360: May damage fertility or the unborn child) Carc. 1A (H350: May cause cancer) STOT Rep. Exp. 2, Affected organs: lung, Route of exposure: Inhalation (H373: May cause damage to organs)
• For environmental hazards: - Hazards to the aquatic environment: - M-factor:	Aquatic Chronic 1 (H410: Very toxic to aquatic life with long lasting effects.) Aquatic acute 1 (H400: Very toxic to aquatic life.) 1

Labelling

Signal word: Danger

Hazard pictogram:

GHS05: corrosion

GHS08: health hazard

GHS09: environment

Hazard statements:

H302: Harmful if swallowed.
H318: Causes serious eye damage.
H317: May cause an allergic skin reaction.
H315: Causes skin irritation.
H350: May cause cancer
H360: May damage fertility or the unborn child
H373: May cause damage to organs
H410: Very toxic to aquatic life with log lasting effects.

Precautionary statements:

P201: Obtain special instructions before use.

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P202: Do not handle until all safety precautions have been read and understood.
P260: Do not breathe dust/fume/gas/mist/vapours/spray.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P264: Wash.hands thoroughly after handling.
P270: Do not eat, drink or smoke when using this product.
P272: Contaminated work clothing should not be allowed out of the workplace.
P273: Avoid release to the environment.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P281: Use personal protective equipment as required.
P310: Immediately call a POISON CENTRE or doctor/physician.
P314: Get medical advice/attention if you feel unwell.
P321: Specific treatment (see... on this label).
P330: Rinse mouth.
P362: Take off contaminated clothing and wash before reuse.
P363: Wash contaminated clothing before reuse.
P391: Collect spillage.
P405: Store locked up.
P501: Dispose of contents/container to...
P301+P312: IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308+P313: IF exposed or concerned: Get medical advice/attention.
P332+P313: If skin irritation occurs: Get medical advice/attention.
P333+P313: If skin irritation or rash occurs: Get medical advice/attention.P333+P313: If skin irritation or rash occurs: Get medical advice/attention.

Copper sulphate pentahydrate (Harmonised classification and labeling listed in Directive 67/548/EEC)

Harmonised classification and labeling published in Directive 67/548/EEC is also applicable to hydrated forms of the compound.

Classification:

The substance is classified as follows:

For health effects	Xn; R22 Harmful; Harmful if swallowed. Xi; R36/38 Irritant; Irritating to eyes and skin.
For the environment	N; R50/53 Dangerous for the environment; Very toxic for aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Labelling:

Indication of danger:
Xn – harmful
N – dangerous for the environment
R-phrases:
R22 – harmful if swallowed
R36/38 – irritating to eyes and skin
R50/53 – very toxic to aquatic organisms, may causes long-term adverse in the aquatic environment
S-phrases:
S2 – keep out of the reach of children
S22 – do not breath dust
S60 – this material and its container must be disposed of as hazardous waste
S61 – avoid release to the environment. refer to special instructions/safety data sheets.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Degree of purity >=98%(w/w).

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Constituents:

Constituent	Typical concentration	Concentration range	Remarks
Copper sulphate pentahydrate EC no. 231-847-6	≥80% w/w	≥80% w/w	

Impurities:

Impurities	Typical concentration	Concentration range	Remarks
Total impurities, each < 1.0	See remarks	See remarks	Individual impurities in copper sulphate pentahydrate are typically present at concentrations <1% w/w, with no substance of concern at concentrations ≥0.1% w/w.
Nickel sulphate EC no: 232-104-9	See remarks	>0.<1% w/w	

Additives:

Constituent	Function	Typical concentration	Concentration range	Remarks
				No additives are present in this substance.

4. FIRST-AID MEASURES

Inhalation	If possible reduce exposure using fresh air. Remove from exposure, take the person to a well aerated place and keep calm. Seek medical advice.
Skin contact	Take off contaminated clothes and wash with soap and plenty of water all the contaminated parts of the body. In case of irritation, seek medical advice.
Eye contact	Wash immediately with plenty of water for at least 15 minutes. Seek medical advice.
Ingestion	If swallowed, seek immediately medical advice. Show this safety data sheet or the label.
General advice	Get medical attention if any discomfort develops. Show this safety data sheet to the doctor in attendance.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media	Product is not flammable. Use extinguishing media appropriate for surrounding fire (micronized water, CO_2, foam). Collect the contaminated water to avoid reaching of sewers or water courses.
Special hazards arising from the substance:	Avoid breathing fumes that could be toxic (presence of sulphur oxides Sox).
Special protective equipment for fire-fighters	Fire-fighters should wear proper protective equipment and self-contained (positive pressure if available) breathing apparatus with full face piece.

6. ACCIDENTAL RELEASE MEASURES

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Personal precautions	Protect adequately all the body parts. The air passages must be protected (suitable filter mask) if the material is in microcrystals form (higher probability that the product forms dust). Keep away unauthorized people, children and animals.
Environmental precautions	Use sand or soil to contain the loss of product. Avoid the possibility that significant quantities of product can enter water courses or sewer; if this should happen advise immediately the local competent authority.
Methods for cleaning up	Cover the product with sand or soil and carefully clean up the product. Put it into another clean and dry container, close and remove it from the area. Do not clean contaminated area with water.

7. HANDLING AND STORAGE

Precautions for safe handling	Avoid dust formation. Do not breathe dust. Handle in a well ventilated area or wear adequate respiratory protection (anti-dust mask). Avoid contact with skin and eyes wearing working clothes, gloves and protective glasses. Do not eat, smoke or drink during use. After use keep the packaging well closed.
Conditions for safe storage, including any incompatibilities	Keep in sealed containers away from humidity and sunlight. Store the product in a well ventilated warehouse away from flammable product. Keep out of the reach of children, animal and unauthorized people. Keep away from food, drink and feeding stuff.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

No data on exposure limit values for copper sulfate.
An overview of the assigned protection factors (APFs) of different RPE (according to BS EN 529:2005) can be found in the glossary of MEASE (www.ebrc.de/mease.html).

8.1 Control parameters of relevance to industrial settings (occurrence of dusts, mist, fumes)

8.1.1 The following current national occupational exposure limit values for copper and copper compounds apply:

Country	Occupational exposure limit	Maximum exposure time	Document number– Date	Basis	Link to the legislation
UK	0.2 mg Cu (fume)/m³ 1 mg Cu (dust and mist)/m³	8h TWA (dust and mist)/m³	2007	Copper	Health and Safety Executive-http://www.hse.gov.uk/coshh/table1.pdf
Finland	0.1 mg Cu (alveolar)/m³ 1 mg Cu (dust and mist)/m³	8h TWA	2009	Copper	The Ministry of Social Affairs and Health-http://pre20090115.stm.fi/hm1113394626349/passthru.pdf
Belgium	0.2 mg Cu (fume)/m³ 1 mg Cu (dust and mist)/m³	8h TWA	2007	Copper	Service public fédéral Emploi, Travail et Concertation sociale-http://www.emploi.belgique.be/WorkArea/showcontent.aspx?id=23914
France	0.2 mg Cu (fume)/m³ 1 mg Cu	8h TWA	2008	Copper	INSTITUT NATIONAL DE RECHERCHE ET DE SÉCURITÉ-http://en.inrs.fr/inrs-pub/inrs01.nsf/IntranetObject-

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	(dust)/m³				accesParReference/ED%20984/$File/ED984.pdf

8.1.2 PNECs and DNELs

Exposure pattern	Route	Descriptor	DNEL / PNEC
Human –Long-term –systemic effects for workers and general population	Oral, dermal and inhalation	Internal dose DNEL (Derived No Effect Level) Using absorption factors of 25% for oral, 100% for inhalation (respirable) and 0.03% for dermal exposure routes	0.041mg Cu/kg B wt/d
Human –Short-term –systemic effects	Oral, dermal and inhalation	Internal dose DNEL (Derived No Effect Level) Using absorption factors of 25% for oral, 100% for inhalation (respirable) and 0.03% for dermal exposure routes	0.082mg Cu/kg B wt/d
Human – Long-term and Short-term	Inhalation	External Inhalation DNEL (Derived No Effect Level) For copper dust and copper fume in Europe in many countries	1 mg/m3 for copper dust 0.1 mg/m3 for copper fume
Human – Long-term and Short-term	Dermal	External Dermal DNEL (Derived No Effect Level) Using dermal penetration factors of 0.03% for dry copper and copper compounds and 0.3% for copper and copper compounds in solution suspension	136.67 mg Cu/kg bw/d for dry copper and copper compounds 13.67 mg Cu/kg bw/d for copper and copper compounds in a slurry/solution
Environmental	Freshwater	PNEC (Predicted No Effect Concentration)	7.8 µg dissolved Cu/L (1)
Environmental	Marine water	PNEC (Predicted No Effect Concentration)	5.2 µg dissolved Cu/L (1)
Environmental	Sediment freshwater	PNEC (Predicted No Effect Concentration) Includes a default bio-availability correction	87 mg Cu/kg dry weight (1)
Environmental	Sediment estuarine	PNEC (Predicted No Effect Concentration)	288 mg Cu/kg dry weight (1) 64 mg Cu/kg wet weight (1)
Environmental	Sediment marine	PNEC (Predicted No Effect Concentration)	676 mg Cu/kg dry weight (1) 148 mg Cu/kg wet weight (1)
Environmental	Soil	PNEC (Predicted No Effect Concentration)	65 mg Cu/kg dry weight (1)
Environmental	STP	PNEC (Predicted No Effect Concentration)	230g dissolved Cu/L
Environmental	birds	PNEC Oral (secondary poisoning)	No potential for bioaccumulation as agreed by the Competent Authorities for Biocides and Existing Substance Regulation

(1) Default PNEC values are given. These can be refined if information on local environment is available.

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8.2 Exposure controls for industrial and professional uses of copper compounds

See the individual exposure scenarios in Annex I for a detailed description of the required exposure control measures. Any control measures and associated efficiency values are based on actual measured data at the workplace or on the MEASE tool for occupational exposure assessment (http://www.ebrc.de/ebrc/ebrc-mease.php).

spERC codes for both industrial and professional uses of copper compounds

In addition to the ERC codes, separate spERCs are available (developed by ARCHE consultants) for 'Metal compound formulation' [spERC F] and 'Industrial use of Metal compounds [spERC U]. These can be applied to downstream use processes that comply with the relevant on-site conditions.

spERC F: This spERC is considered appropriate for both open and closed systems using both wet and dry processes and is based on information gathered for metal compounds used in formulation activities. The activities listed include mixing and blending of metal compounds into preparations in the following formulating industries: catalysts, glass, pigments, paints, coatings, plastics, rubber stabilisers and water treatment chemicals (note, however, that the spERC may also be applied to other formulating industries, provided they meet the criteria discussed below). The spERC has been developed by considering how the existing appropriate RMMs can be used to achieve the necessary reduction in emissions. For air emissions, the spERC value was based on the finding that RMMs for air present in >80% of the sites included:
Electrostatic precipitation;
Fabric or bag filters (most common);
Ceramic filters;
Wet scrubbers (most common);
Dry or semi-dry scrubbers.

From the available data, the maximum 90th percentile reported site-specific release factor to air (after RMM) from the formulation processes investigated was 0.004%.

For the releases to waste water the spERC value was based on the RMMs for water present in >60% of the sites including:
Chemical precipitation;
Sedimentation;
Filtration;
Electrolysis (rare).

The 50th percentile of the reported site-specific removal efficiency for 18 sites was 94% (50.00% – 93.30%). The maximum emission of the 90th percentiles of reported site-specific release factors to waste water was given as 0.5%. This is a worst-case assumption as waste water RMMs were confirmed at >60% site, suggesting that the 90th percentile release factor did not include RMMs. Therefore, an additional on-site removal step via an on-site WWTP may be added to the exposure scenario.

Emissions to soil were not considered to be relevant to metal compound formulation as the activities are undertaken largely indoors.

spERC U: This spERC is considered appropriate for both open and closed systems using both wet and dry processes and is based on information gathered for the use of metal compounds in the following industrial sectors: crystal manufacture, leather tanning, pigments, paints, coatings, plastics, rubber and textiles (note, however, that the spERC may also be applied to other sectors, provided they meet the criteria discussed below). The spERC has been developed by considering how the existing appropriate RMMs can be used to achieve the necessary reduction in emissions. For air emissions, the spERC value was based on the findings that the RMMs for air present in >50% of the sites included:

- Electrostatic precipitation;
- Fabric or bag filters (most common);
- Ceramic filters;
- Wet scrubbers (most common);
- Dry or semi-dry scrubbers.

From the available data the maximum 90th percentile reported site-specific release factor to air (after RMM) from the activities investigated was 0.1%.

For the releases to waste water the spERC value was based on the RMMs for water present in >50% of the sites including:
Chemical precipitation;
Sedimentation;

Filtration;
Electrolysis.

The 50th percentile of the reported site-specific removal efficiency for 12 sites was 95% (50.00% – 99.95%). The maximum emission of the 90th percentiles of reported site-specific release factors to waste water was given as 0.6% (after on-site RMM).

While site specific scaling with additional RMMs will be possible for individual sites, insufficient information is currently available for any further amendment of the generic spERC scenario.

The exposure resulting from the generic scenarios is presented below.

For appropriate air monitoring," total" and "respirable" copper levels should be assessed. An Excel sheet that allows the systemic internal human health exposure levels to be calculated is available from: http://www.eurocopper.org/copper/reach.html.

All downstream use exposure scenario predictions are based on the standard EUSES 2.0 model for the environment and MEASE for worker exposure, in line with the available guidance for REACH. The Metal EUSES calculator for Downstream Uses which can be freely downloaded from http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool. For environmental monitoring, the physico-chemical characteristics of the local receiving environment should preferably be monitored.

8.2.1 Appropriate engineering controls at industrial settings
Prevent formation of dust where possible. Use local exhaust ventilation, sealed equipment and package or other exposure level control devices to maintain concentration in air below recommended exposure limits.
Any deposit of dust which cannot be avoided should be regularly removed preferably using appropriate industrial vacuum cleaners or central vacuum systems.
In case of inadequate ventilation or risk of inhalation of dust, use suitable respiratory equipment with particle filter (type P2). Seek advice from local supervisor.
Waste air should be released into the atmosphere only after it has passed through suitable dust separators.
Waste water generated during the production process or cleaning operations should be collected and should preferably be treated in an on-site or off-site waste water treatment plant which ensures efficient (min. 92 %) removal of copper.

8.2.2 Individual protection measures, such as personal protective equipment
Eye/face protection:
Copper sulphate is considered to be classified as a severe eye irritant. Wearing of suitable safety glasses is compulsory.

Skin protection:
Copper sulphate is classified as a skin irritant. Wearing of gloves and protective clothes is compulsory.

Respiratory protection:
Avoid generation of fumes and dusts.
Avoid generation and spreading of dust - Use local ventilation to keep levels below established threshold values. A suitable particle filter mask is recommended.

Thermal hazards
Not applicable. Copper does not have any self-heating or auto-flammable properties.

Hygiene measures
Store and handle in accordance with good industrial hygiene and safety practices. Wash hands after handling. Routinely wash work clothing and protective equipment to remove contaminants. Observe any medical surveillance requirements.

8.2.3 Environmental exposure controls
Avoid release to the environment.

9. PHYSICAL AND CHEMICAL PROPERTIES

Property	Value	Remarks

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Physical state at 20° and 101.3 kPa	Solid	Form: Crystalline Colour: Blue Odour: odourless
Melting point/Freezing point	Decomposes at 110°C	
Boiling point	Decomposes at 110°C	
Relative density	≥2.286 g/cm3	
Vapour pressure	Not applicable	Copper sulphate pentahydrate is an inorganic salt and as such has negligible volatility at environmentally relevant temperatures.
Surface tension	Not applicable	Surface tension is not applicable to inorganic salts.
Water solubility	≥22g/100g H2O	pH and temperature is not stated.
Partition coefficient n-octanol/water (log value)	Not applicable	The octanol: water partition coefficient, Pow, is defined as the ratio of the equilibrium concentrations of a dissolved substance in each of the phases in a two phase system consisting of octanol and water. It is usually expressed on a log scale. It is a key parameter in studies of the environmental fate of organic substances, indicating the potential for bioaccumulation and soil absorption. However, the mechanisms of absorption of Cu^{2+} into organic matter and living cells are understood to be different from those traditionally attributed to carbon-based substances and the parameter therefore has little relevance to ionic copper. The parameter is therefore not considered to be relevant to copper sulphate pentahydrate.
Flash point	Not applicable	The determination of flash point is not required because the active substance is a solid.
Flammability	Not applicable	Copper sulphate pentahydrate is an organic salt with copper in a high oxidation state. As such this material is not likely to undergo self heating under bulk storage conditions and is unlikely to auto-ignite. Self heating orauto-ignition has not been observed with copper sulphate pentahydrate following use for many years.
Explosive properties	Not applicable	Copper sulphate pentahydrate is a stable inorganic substance. None of these components or grouping are associated with explosive hazards. All are stable groupings in high oxidation states. Copper sulphate pentahydrate therefore will not have explosive properties and experience in use over many years confirms this conclusion.
Self-ignition temperature	Not applicable	Copper sulphate pentahydrate is an organic salt with copper in a high oxidation state. As such this material is not likely to undergo self heating under bulk storage conditions and is unlikely to auto-ignite. Self heating orauto-ignition has not been observed with copper sulphate pentahydrate following use for many years.
Oxidizing properties	Not applicable	Oxidizing compounds are materials that can easily transfer oxygen to the other compounds,

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		i.e. they contain weakly bound oxygen, for example NO_3 and peroxides. Bound oxygen must also become available through a low energy of activation. The oxygen in copper sulphate pentahydrate is bound in stable sulphate structural groupings with strong oxygen bonds. The decomposition temperature of copper sulphate pentahydrate is also indicating a high energy of activation. Copper sulphate pentahydrate is therefore considered inert under the conditions of oxidation. Experience in using copper sulphate pentahydrate over many years also indicates that it is not associated with oxidisinghazards.
Granulometry	Five different copper compounds were subjected to total particle size analysis, resulting in d50 values in the range 3.3-220.4 µm. The results of this exercise are illustrative of the range of Particle Size Distributions found across whole copper industry and are therefore inclusive of copper sulphate from the large majority of sources.	To account for the possibility that materials with a smaller particle size may be produced for certain specialist uses, the Exposure Scenarios developed under REACH are based on the worst-case assumption that 100% of any material becoming airborne is respirable.
Stability in organic solvents and identity of relevant degradation products	Not applicable	As stated in the REACH regulations, the study does not need to be conducted if the substance is inorganic.
Dissociation constant	Not applicable	Dissociation is a reversible equilibrium process where a species exists either in an ionized or an unionized solution state. The dissociation constant (pKa) is effectively the ratio of the associated (unionized) to dissociated (ionized) substance in solution. Copper is a poorly soluble metallic element that can only remain in solution in a totally dissociated ionic state: a non reversible process. Since it solubility is low and it does not exist in solution in an associated state, it does not therefore have a measurable dissociation constant.
Viscosity	Not applicable	The determination of viscosity is not required because the active substance is a solid.
Auto flammability	Not applicable	Copper sulphate pentahydrate is an organic salt with copper in a high oxidation state. As such this material is not likely to undergo self heating under bulk storage conditions and is unlikely to auto-ignite. Self heating orauto-ignition has not been observed with copper sulphate pentahydrate following use for many years.

10. STABILITY AND REACTIVITY

Reactivity	Not applicable
Chemical stability	Copper sulfate is stable under normal conditions of use, storage and transport.
Possibility of hazardous reaction	Reaction with H- equivalents releases soluble copper compounds.
Conditions to avoid	Avoid dust formation and contact with acids.

Incompatible materials	Acids. Alkalis. Organic substances. Interacts with ammonia; forms complex salts.
Hazardous decomposition products	Not applicable.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

The toxicological information was obtained from the Risk Assessment Report on copper and copper compounds, assessed by the EC Technical Committee for New and Existing Substances (TCNES) and the EC Scientific Committee on Health and Environmental Risks (SCHER) (see: http://echa.europa.eu/chem_data/transit_measures/vrar_en.asp), and supplemented with recent information gathered for the REACH registration. The additional information confirms the hazard profile derived for copper sulphate pentahydrate as well as the DNELs derived.

Most of the available hazard data are related to exposure of soluble copper compounds, i.e. copper sulphate. Information on solubility, bioaccessibility and bioavailability is combined for the hazard profile of copper in massive forms with the hazard profile of soluble copper compounds in a read-across approach to assess its potential hazards.

As far as copper sulphate pentahydrate contents NiSO4 in the amount of >0.3< 1%, its toxicological data given below is affected with classification of nickel sulphate. The toxicological information on nickel sulphate was obtained from the Risk Assessment Report on nickel and nickel compounds and supplemented with recent information gathered for the REACH Registration.

Health effects of NiSO4

Acute toxicity – oral:	Acute Tox. 4 (Hazard statement: H302: Harmful if swallowed)
Acute toxicity – dermal:	Reason for no classification: conclusive but not sufficient for classification.
Acute toxicity – inhalation:	Acute Tox. 4 (Hazard statement: H332: Harmful if inhaled)
Skin corrosion/irritation:	Skin Irrit.2 (Hazard statement: H315: Causes skin irritation)
Serious damage/eye irritation:	Reason for no classification: conclusive but not sufficient for classification.
Aspiration hazard:	Reason for no classification: data lacking.
Reproductive toxicity:	Perp. 1B (Hazard statement: H360: May damage fertility or the unborn child)
Reproductive toxicity: Effects on or via lactation:	Reason for no classification: conclusive but not sufficient for classification.
Germ cell mutagenicity:	Muta. 2 (Hazard statement: H341: Suspected of causing genetic effects)
Carcinogenicity:	Carc. 1A (Hazard statement: H350: May cause cancer)
STOT-single	Reason for no classification: conclusive but not sufficient for classification.
STOT-repeated:	STOT Rep. Exp.1 (Hazard statement: H372: Causes damage to organs. Affected organs: respiratory tract Route of exposure: inhalation

Health effects of $CuSO_4 * 5H_2O$

Toxicity endpoints	**Description of effects**

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ORAL Oral absorption data for humans and rats show qualitative and quantitative similarities between two species. In both species, absorption of copper over the range of intakes studied is inversely related to copper intake, illustrating the important role of absorption in copper homeostasis. In both species, true absorption of copper from diets containing what are considered as adequate levels of copper (1-10 mg/day in humans; 0.3-0.6 mg/day bw/day in animals) is in the 30-60% range. The above oral absorption data and corresponding functions are based on copper sulphate. Assuming that orally-administered copper will occur in the GIT, at least in part, in the ionic form and therefore be available for absorption, and in view of the solubility of copper sulphate, it is considered appropriate to adopt a conservative approach and to use the oral absorption data for copper sulphate for other less soluble copper species.
Following administration of soluble copper compounds, a dose dependent adsorption of copper ions has been drawn from true pooled fitted data (exposure-specific absorption). The essential nutritive value of copper-ions drives this homeostasis with a copper absorption ranging between 20 % (high copper intake - near toxicity) to 80 % (low copper intake - near deficiency) for soluble copper compounds. Considering the most reliable human data currently available (Turnlund et al , 1989; 1998; 2005 and Harvey et al, 2003; 2005), for a given soluble copper dose in the Gastro Intestinal Tract, oral absorption of copper in humans can be calculated based on the mean result for two functions:

Equation 1 oral absorption% = -15.0 ln(x) + 63.2
Equation 2 oral absorption% =72.9 e-0.1167x
x= copper intake (mg/day)

DERMAL With regard to dermal absorption of copper, two in vitro studies using human skin provide the best data currently available (Roper 2003; Cage 2003). Based on these two studies, a dermal absorption factor of 0.3% is derived for insoluble and soluble copper substances in solution or suspension and is used in risk characterisation.
For the dry exposure scenarios applicable to copper powders, the dermal absorption value of 0.03% applies.

INHALATION In absence of relevant inhalation absorption data, the inhalation absorption will be calculated using the Multiple Path Model of Particle Deposition (MPPD) and particle size distribution data of the copper and copper compounds.
The absorption of the respirable fraction (fumes) is considered to be complete (100%). Copper deposited in the upper respiratory tracts (ET and TB fractions) was assumed to be translocated to the gut.

On entering interstitial fluid and blood plasma, absorbed copper initially becomes bound to two proteins: albumin and transcuprein. Most of the copper bound to albumin and transcuprein is rapidly transported via portal blood to the liver. Once in the liver, copper is incorporated into ceruloplasmin, which is subsequently release into the systemic circulation for delivery to other tissues (Lee it al., 1993; Scott & Turnlund, 11994).

Acute toxicity

ORAL: At high levels, solubilised copper-ions may induce gastro-Intestinal effects. Acute oral effects, assessed from animal studies using CuO (Sanders, 2002a), copper sulphate (Lheritier, 1994) and coated copper flakes (Sanders, 2001a) are available. Comparison of the toxicity profiles demonstrates the importance of solubility/bio-accessibility for read-across of toxicity data among copper-bearing substances. The available animal data combined with in-vitro bio-accessibility data permitted the assessment of the acute toxicity of copper in powder and massive form.

The assessment concluded that, according to the Regulations (EC) No 1272/2008 and 67/548/EEC, copper sulphate meet the criteria as acute harmful by oral intake (LD50 rats>300 mg/kg body weight).

Acute gastrointestinal effects associated with copper sulphate additions to drinking water were investigated in humans (Araya et al, 2001 and 2003) and a NOAEL of 4mg Cu/L was derived. At higher doses (6 to 8 mg Cu as CuSO4/L, administered as a bolus on an empty stomach) nausea was the most frequently reported symptom (10% at 6 mg/L and 18% at 8 mg/L) and generally occurred within 15 minutes of administration. Other gastrointestinal symptoms (vomiting, diarrhoea and abdominal pain) were reported less frequently and abdominal pain showed no relationship to concentration.

DERMAL: Consideration of available acute dermal toxicity data on copper compounds

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	(copper sulphate (Lheritier, 1993) (LD50>2000 mg/kg body weight) against EU classification criteria, according to Regulations (EC) No 1272/2008 and 67/548/EEC, leads to the conclusion that copper nor any of the tested copper compounds require classification for acute lethal effects after dermal exposure. The classification criteria for very fine and soluble "copper" bearing substances, including copper sulphate according to the regulations (EC) No 1272/2008 and 67/548/EEC on acute toxicity, lead to a classification as "harmful if swallowed and if inhaled".
STOT single exposure	The effects following acute toxicity (oral and inhalation – see above) have been used for the classification as harmful. The local oral and inhalation effects resulted in mortality.
Skin/eye irritation/corrosion	The data have demonstrated that according to Regulations (EC) No 1272 and 67/548/EEC, copper sulphate pentahydrate is irritating to skin. Animal studies induced that copper sulphate pentahydrate is considered to be classified as a severe eye irritant (H319). From the dermal and eye irritation studies, copper sulphate is not a corrosive compound.
Respiratory or Skin Sensitisation	There are no applicable data available on the irritancy of copper sulphate pentahydrate on the respiratory tract. Copper sulphate does not meet the criteria for classification as a skin sensitizer. There are no applicable data available on the sensitization potential of copper sulphate pentahydrate in respiratory tract.
Genotoxicity	Public domain data indicate that copper sulphate is negative in vitro in bacterial cell reverse mutation assays, and in several other bacterial cell assays up to and including cytotoxic doses (1000-~3000 µg/plate). Results from in vitro mammalian cell tests show that copper sulphate is genotoxic only at high, cytotoxic concentrations (up to 250 mg/l). Two in vivo genotoxicity studies performed on a soluble copper compound (copper sulphate), in accordance to respectively OECD 486 and EU B.12 were negative (Ward, 1994 and Riley, 1994). From the results, copper sulphate pentahydrate, copper and other copper compounds are not considered genotoxic.
Carcinogenicity	All available studies on the carcinogenicity of copper are public domain studies but study qualities are limited due to shorter exposure periods (<2 years) and small group sizes (Carlton et al., 1973; Burki and Okita, 196 and Harrison et al., 1954). However, using these studies in a weight of evidence approach, it was concluded that copper compounds do not raise concerns with respect to carcinogenic activity.
Toxicity for reproduction	The two-generation high quality study (Mylchreest, 2005) indicates that the no-observed-adverse-effect level (NOAEL) for reproductive toxicity of a soluble copper compound (copper sulphate pent hydrate) in rats is > 1500 mg/kg food or >24 mg Cu/kg bw/d, the highest dose tested. At the highest dose, slight non-reproductive toxicity effects (transient effect on spleen weight) were observed. In addition, the existing data base is now sufficient to adequately evaluate the developmental toxicity of copper with particular reference to the newly available two-generation study in the rat. It is therefore considered inappropriate to observe copper and copper compounds as potential teratogenic compounds due to the complex role of copper in regulating normal foetus development in humans at levels considered higher than would be expected to occur through the normal production and use of any copper compound.
Repeated dose toxicity and STOT-	NOAELoral rat = 16,7 mg Cu /kg body weight/day (Hebert C.D., 1993). Following repeated administration of $CuSO_4$ in the feed for 13 weeks produced effects in the forestomach, liver and kidney. Inflammation of the liver occurred in male and female animals at 260 mg

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RE CuSO4/kgBW/day and above. The incidence and severity of the effects were dose-dependent. This study was used in the subsequent calculation of an oral and systemic DNEL (including a Safety factor of 100 and an oral absorption of 25%) of 0.041 mg Cu/kg body weight/day.

12. ECOLOGICAL INFORMATION

The ecotoxicological information was obtained from the Risk Assessment report on copper and copper compounds, assessed by the EC Technical Committee for New and Existing Substances (TCNES) and the EC Scientific Committee on Health and Environmental Risks (SCHER) (see: http://echa.europa.eu/chem_data/transit_measures/vrar_en.asp), and supplemented with recent information gathered for the REACH registration The additional information confirms the hazard profile derived for copper sulphate and refined the PNECs derived for the some compartments (soil and marine waters).

Most of the available hazard data are related to exposure of soluble copper compounds, i.e. copper sulphate. Information on solubility and bioavailability are combined for copper massive forms and the hazard profile of soluble copper compounds in a read-across approach to assess its potential hazards.

12.1 Ecotoxicity

Bioavalability of the Cu^{2+} ions in both laboratory tests and environment may be affected by abiotic factors (such as pH, alkalinity, hardness and DOC for the water compartment) and therefore copper bioavalability is considered for the interpretation of the copper effects data.

Acute aquatic toxicity The acute toxicity of soluble copper ions was assessed from studies on soluble copper compounds. From a literature search 451 high quality L (E)C50 values were retained. For the algae 66 individual data points were selected for 3 standard species (Pseudokirchnerella subcapitata, Chamydomonas reinhardtii and Chlorella vulgaris). For the invertebrates 123 individual data points were selected for 2 standard species(Ceriodaphnia dubia and Daphnia magna) and for the fish 262 individual data points were selected for 5 standard species (Oncorhynchus mykiss, Pimephales promelas, Lepomis macrochirus, Brachydanio rerio and Cyprinus carpio). The data were treated and summarized in accordance with the CLP guidance (2009) to derive the pH dependent acute reference value. The lowest species-specific geometric mean L(E) C50 reference was obtained for an invertebrate (Ceriodaphnia dubia) at pH 5.5-6.5 with an acute L(E)C50 of 25.0 µg Cu/L (Van Sprang et al., 2010).

Chronic aquatic toxicity: freshwater The chronic toxicity of soluble copper ions was assessed from studies on soluble copper compounds. 139 individual NOEC/EC10 values resulting in 27 different species-specific soluble Cu-ions NOEC values, covering different trophic levels (fish, invertebrates and algae) were used for the PNEC derivation. The large intra-species variability in the reported single species NOECs was related to the influence of test media characteristics (e.g., pH, dissolved organic carbon (DOC), hardness) on the bioavailability and thus toxicity of copper. Species-specific NOECs were therefore calculated after normalizing the NOECs towards a series of realistic environmental conditions in Europe (typical EU scenario's, with well-defined pH, hardness and DOC). Such normalization was done by using chronic copper bioavailability models (Biotic Ligand Models), developed and validated for three taxonomic groups (fish, invertebrates and algae) and additional demonstration of the applicability of the models to a range of other species. The species-specific BLM-normalized NOECs were used for the derivation of log-normal Species Sensitivity Distributions (SSD) and HC5 values (the median fifth percentile of the SSD), using statistical extrapolation methods to derive a PNEC. The data allow the derivation of PNECs for the typical EU scenario ranging between 7.8 to 22.1 µg dissolved Cu/L. Additional BLM scenario calculations for a wide range of surface waters across Europe further demonstrated that the HC5 of 7.8 µg dissolved Cu/L, is protective for 90% of the EU surface waters and can thus be considered as a reasonable worst case for Europe in a generic context.

Copper threshold values were also derived for three high quality mesocosm studies, representing lentic and lotic systems. The mesocosm studies included the assessment of direct and indirect effects to large variety of taxonomic group and integrate potential effects from uptake from water as well as from food. The results confirm the BLM

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normalized single species threshold values.

Conclusion: a value of 7.8 µg dissolved Cu/L is the default chronic freshwater PNEC, to be used to assess local risks. The assessment can be refined if information on local water chemistry (dissolved organic carbon, pH, calcium, magnesium, sodium and alkalinity) is available.

Chronic aquatic toxicity: marine

The chronic toxicity of soluble copper ions was assessed from studies on soluble copper compounds. 56 high-quality chronic NOEC/EC10 values, resulting in 24 different species-specific soluble Cu-ions NOEC values covering different trophic levels (fish, invertebrates, algae, aquatic plants), were retained for the PNEC derivation. NOEC values were related to the Dissolved Organic Carbon (DOC) concentrations of the marine test media. Species-specific NOECs were therefore calculated after DOC normalizing of the NOECs. These species-specific NOECs were used for the derivation of species sensitivity distributions (SSD) and HC5 values, using statistical extrapolation methods. The organic carbon normalization was carried out at a DOC level typical for coastal areas (2 mg/l) and resulted in an HC5 value of 5.2 µg Cu/L.
A Copper threshold value was also recently derived from a high quality marine mesocosm study (Foekema et al., 2010). The mesocosm studies included the assessment of direct and indirect effects to large variety of taxonomic group and integrate potential effects from uptake from water as well as from food. The results confirm the DOC normalized single species threshold values.

Conclusion: a value of 5.2 µg dissolved Cu/L is the default chronic marine water PNEC, to be used to assess local risks. The assessment can be refined if the dissolved organic carbon concentration of the local environment is available.

Sediment toxicity

Chronic freshwater toxicity test results and PNEC derivation

The sediment PNEC included using a weight of evidence approach considering different sources and tiered approaches of information: (1) benthic sediment ecotoxicity data from spiking sediments with of soluble copper compound, (2) pelagic ecotoxicity data in combination with water-sediment partitioning coefficients (Kd values) derived through different approaches, (3) soil ecotoxicity data and soil bioavailability models and (4) mesocosm/field ecotoxicity.
High-quality chronic benthic NOECs for six benthic species, representing 62 NOEC values were retained for the PNEC derivation. NOEC values were related to sediment characteristics (e.g., Organic Carbon (OC) and Acid Volatile Sulphides (AVS)), influencing the bioavailability and thus toxicity of copper to benthic organisms. The derivation of the freshwater HC5 sediment for copper was therefore based on the OC-normalized dataset, containing only low-AVS sediments.

An HC-5 of 1741 mg Cu/kg OC, corresponding to 87 mg Cu/kg dry weight for a sediment with 5 % O.C. (TGD default value) is used.

Conclusion: a value of 87 mg Cu/kg dry weight is the default chronic freshwater sediment PNEC, to be used to assess local risks. The assessment can be refined if the organic carbon concentration and the Acid Volatile Sulphide concentrations of the local sediment is available.

Chronic terrestrial toxicity test results and PNEC derivation

Chronic terrestrial toxicity is derived from spiking of soils with soluble copper compounds. A high-quality dataset of 252 individual chronic NOEC/EC10 values from 28 different species and processes representing different trophic levels (i.e., decomposers, primary producers, primary consumers) has been retained for the PNEC derivation.
Additionally information on 8 single species studies in field contaminated soils and 5 multispecies studies (freshly spiked and field contaminated) were used for as additional WOE for the PNEC derivations of the freshwater and the sediment compartment.
The observed intra-species differences in toxicity data were related to differences in bioavailability: the latter related to differences in soil properties and to differences in ageing and application mode and rate.

The soil property best explaining the variability in toxicity for most of the endpoints was the eCEC (effective Cation Exchange Capacity). To account for the observed difference between lab-spiked soils and field-contaminated soils, a conservative leaching-ageing factor of 2 was agreed based on test data from the mechanistic research on ageing and ionic strength (leaching) effects. For the normalisation of the ecotoxicity data, first the

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	leaching-ageing factor was applied on all added NOEC/EC10 values. These adjusted values, after addition of the respective Cu background concentrations, were subsequently normalised to a wide range of EU soils using the relevant regression (bio) availability models, generating soil-type specific HC5 values and a derivation of the PNEC. Species Sensitivity Distributions were constructed using the normalised NOEC/EC10 data. HC5 values from log-normal distributions ranging between 65.5 and 150 mg Cu/kg dry weight were obtained (Oorts et al., 2010). A total of eight single species studies were available in which the toxicity of Cu to micro-organisms, invertebrates and plants in field-contaminated aged soils was investigated for a wide range of European soil types (peaty, sandy, clay). A total of five multi-species studies were available, three of which studied the effects of copper in freshly spiked soils and two in field contaminated aged soils. Invertebrates, plants and micro-organisms were studied. Single-species and multi-species field studies indicate that effects did not occur at an exposure level at the HC5value. See Copper Risk assessment Report **Conclusion: a value of 65.5 mg Cu/kg dry weight is the default chronic soil PNEC, to be used to assess local risks. The assessment can be refined if the pH and Cation Exchange Capacity of the local soil is available.**
Toxicity to micro-organisms in STP	Data on the toxicity tests performed with aquatic bacteria and protozoa, reported as L(E) C50and NOEC values. The following high quality publications were selected for assessing the toxic effects of copper on bacterial populations: Dutka (1983), Waara (1992), Madoni et al., (1996), Milksch & Schürmann (1988), Almanza et al., (1996), Fiebig & Noack (2004) and the results from the Cha et al., (2003) research project. The date from Sauvant et al., 1997 ; Schäfer et al., 1994, Girling et al., 2000 were used for assessing the effects on protozoan populations. The bacterial studies using mixed population tests (e. g. activated sludge) representative for microbial degradation in STP, resulted in NOEC values (reported as total or nominal concentrations) ranging from <0.5-1 and 5.4 mg/l for the heterotrophs and between 3.5 and >20 mg/l for the nitrifiers. The EC50values for the micro-organisms representative for microbial degradation in STP range from 2.1 to 26 mg/l Cu (as total or nominal copper) for the heterotrophs and between 9.9 and 49.1 mg/l for the nitrifiers (as total or nominal copper). Protozoan tests resulted in NOEC/L(E) C50 values depending on the test species and test-set-up used. The short term tests with T. pyriformis, the species recommended by the TGD/REACH(1996, revisions 2003), resulted in NOEC and EC50(growth) values between, respectively, 3.6 - 3.8 mg/l and 8.0-10.2 mg/l nominal copper. These toxicity test results are based on short term experiments (between 2 and 4 days) performed in artificial media. The results obtained from protozoan communities were deemed to be more representative for the functioning of STPs and were therefore retained for the PNEC derivation. Across endpoints/studies 0.23 mg dissolved Cu/L was considered as the most reliable NOEC. **PNEC for Sewage Treatment Plant is 230 µh/l , AF 1, Extrapolation method: statistical extrapolation as agreed by the Competent Authorities for Biocides and Existing** **Substance Regulations.**

12.2 Persistence and degradability

"Copper" cannot be degraded, but may be transformed between different phases, chemical species, and oxidation states.

In accordance to the EU 2009 CLP guidance, the fate of the copper ion under "environmentally relevant" conditions was modelled, using the Ticket Unit World Model. Rapid removal from the water column was also assessed using data from one mesocosm and three field studies (Rader et al., 2010). The assessment demonstrated the rapid removal of copper-ions, delivered as soluble copper compounds, from the water column under "normal environmental conditions". Rapid removal of a substance from the water column is defined as 70% removal within 28 days. Literature data demonstrates the strong binding of copper-ions to sediment materials and especially the anaerobic CuS complexes are very stable (Simpson et al., 1998; Sundelin and Erickson, 2001). The remobilisation of Cu-ions to the water column is therefore not expected. The assessment therefore demonstrates that "copper" does not meet the criterion as "persistent".

12.3 Bioaccumulative potential

The following information is taken into account for any hazard / risk / bioaccumulation assessment:

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There is a considerable amount of copper accumulation data available. The data have been reviewed by two authors in view of assessing the relation between the Cu BCF/BAF values and the copper concentrations in the water and sediment. Additionally some researchers have assessed the influence of water chemistry (dissolved organic matter), and the physiology of the organisms (species, age, seasons...) on the observed BCF/BAF values.
The information demonstrates that copper is well regulated in all living organisms and that BCF and BAF values have no meaning for a hazard assessment.
The data also demonstrate that waterborne exposure is most the critical exposure route and that copper is not biomagnified in aquatic ecosystems.
Based on the available information, there is no indication of a bioaccumulation potential and, hence, secondary poisoning is not considered relevant (see CSR chapter 7.5.3 'Calculation of PNECoral (secondary poisoning) '.

12.4 Mobility in soil

Copper-ions bind strongly to the soil matrix. The binding depends on the soil properties. A median water-soil partitioning coefficient (Kp) of 2120 L/kg has been derived for soils (more details see Copper Risk Assessment Report, 2008 and Copper Chemical Safety Report, 2010).

12.5 Results of PBT and vPvB assessment

The PBT and vPvB criteria of Annex XIII to the Regulation do not apply to inorganic substances, such as copper and its inorganic compounds.
Copper is not PBT or vPvB.

12.6 Other adverse effects

Copper is not expected to contribute to ozone depletion, ozone formation, global warming or acidification.

13. DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility.

14. TRANSPORT INFORMATION

ADR/RID	No. UN-3077, Class 9, Packaging Group III.
IATA/ICAO	No. UN-3077, Class 9, Packaging Group III.
IMDG	Copper sulfate is sea pollutant. Emergency cards F-A S-F if transported by sea.
SMGS(Agreement on International Goods Transport by Rail Road)	Hazard code - 90-other dangerous and hazardous substances, number in Table - 12c) Emergency card No. 906 if transported by rail.

15. REGULATORY INFORMATION

EC Number	231-847-6

16. OTHER INFORMATION

The data herein are based on our latest knowledge but do not constitute a guarantee for any specific product features and do not establish any legally valid contractual relationship.

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ABBREVIATIONS:

TCNES: EC Technical Committee for New and Existing Substances (TCNES)
SCHER: EC Scientific Committee on Health and Environmental Risks
REACH: EC Regulation on Registration, Evaluation and Authorisation of Chemicals (Regulation (EC) No 1907/2006 as amended)
LD50: Lethal dose to 50% of the test organisms
LC50: Lethal concentration to 50% of the test organisms
LC10: Lethal concentration to 10% of the test organisms
EC10: Effective concentration to 10% of the test organisms

NOEC: No Observed Effect Concentration = highest concentration tested without effects
DNEL: Derived No-Effect Level
SSD: Species Sensitivity Distribution= distribution of the species-specific NOEC or (L(E)C10 values for all species tested.
HC-5: The concentration without effect for 95% of the species = statistically derived environmental threshold value.
PNEC: Predicted No-effects Concentration
DOC: Dissolved Organic Carbon
OC: Organic Carbon
CEC: Cationic Exchange Capacity
AVS = Acid Volatile Sulphide.

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ANNEX I
GENERIC EXPOSURE COPPER SULPHATE

The downstream uses of copper sulphate are considered in terms of user (industrial, professional, consumer) and environmental exposure route (point source and wide dispersive emissions). The range of copper sulphate uses is very diverse and, in order to provide assessments that can be applied as flexibly as possible, all potential worker activities (expressed in terms of PROC codes) and routes of environmental exposure (expressed as ERCs and spERCs) have been evaluated. These are treated as individual generic exposure scenarios (GES). In all cases, human and environmental exposure is expressed in terms of copper. Worker exposure scenarios also distinguish between the use of copper compounds in either liquid (assumed to be a solid at room temperature dissolved in water to produce an aqueous solution or slurry) or solid form. Solid forms are further classified as having low, medium or high dustiness, as defined by the developers of MEASE using the Rotating Drum Method (RDM);

1. Solid, low dustiness: Granules, pellets, wetted powders, etc. with little potential for dust emissions (dustiness is less than 2.5% according to the RDM).
2. Solid, medium dustiness: powders and dust consisting of relatively coarse particles with moderate potential to become (and stay) airborne (dustiness is less than 10% RDM).
3. Solid, high dustiness: fine powders having high potential to become and stay airborne.

The RMD methodology is defined within the European Committee for Standardization (CEN/TC137/WG3) 2006 document providing standardisation in measurement of dustiness of bulk powders (EN15051[1]). This standard establishes two reference test methods (single drop or rotating drum method) that classify dustiness in terms of health-related fractions of bulk solid materials.

The resulting scenarios, including information on associated operating conditions and risk management measures, are summarized in the tables that follow. In order to clearly identify each GES for downstream use of copper sulphate, the following descriptor codes have been developed: Environmental GES all have the prefix **E-GES;** worker GES all have the prefix **W-GES** (industrial) or **PW-GES** (professional) and consumer GES have the prefix **C-GES**. All of these then have '**DU**' for downstream use or '**WDU**' for widespread downstream use, as applicable. In order to define the specific release category or activities investigated within individual GES, a number of additional sub-categories have been added:

Scenario			Description
E-GES-DU	Tier	1	Tier 1 – defaults from ERC codes
		2	Tier 2 – spERC[†]/measured data
	Waste water treatment	0	No waste water emission
		1	Waste water treated once at STP*
	Environmental release category (ERC)	(2)	Formulation of mixtures
		(3)	Formulation in materials
		(4)	Industrial use of processing aids in processes and products, not becoming part of articles
		(5)	Industrial use resulting in inclusion into or onto a matrix
		(6a)	Industrial use resulting in manufacture of another substance (use of intermediates)
		(6b)	Industrial use of reactive processing aids
		(6d)	Industrial use of process regulators for polymerisation

[1] European Committee for Standardization. EN 15051. Workplace atmospheres - Measurement of the

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Scenario			Description
			processes in production of resins, rubbers, polymers
		(7)	Industrial use of substances in closed systems
		(12a)	Industrial processing of articles with abrasive techniques (low releases)
		(spERC F)	Industrial formulation of metal compounds
		(spERC U)	Industrial use of metal compounds
E-GES-WDU	Environmental release category (ERC)	(ERC8a-c)	Wide dispersive indoor use of substance
		(ERC8d-f)	Wide dispersive outdoor use of substance
		(ERC9a)	Wide dispersive indoor use of substance in closed systems
		(ERC9b)	Wide dispersive outdoor use of substance in closed systems
		(ERC10a)	Wide dispersive outdoor use of long-life articles with low release
		(ERC10b)	Wide dispersive outdoor use of long-life articles with high or intended release
		(ERC11a)	Wide dispersive indoor use of long-life articles with low release
		(ERC11b)	Wide dispersive indoor use of long-life articles with high or intended release
W/PW-GES-DU	Substance form	(High)	Solid, high dustiness
		(Med)	Solid, medium dustiness
		(Low)	Solid, low dustiness
		(Liquid)	Liquid, aqueous solution or slurry
C-GES-DU	Various unspecified articles and products		

† In addition to the ERC codes, spERCs have been developed to assess exposure from downstream formulation and use. These are applicable to open and closed systems using wet and dry processes and are based on specific RMM information gathered for metal compounds in various industrial activities. spERCs may be applied in preference to the default ERCs for sites that are known to comply with the stipulated conditions.

* On-site WWTP can be introduced where applicable; Use of a sewage treatment plant (STP) presents a worst-case approach, as this allows for an assessment of risk to STP microorganisms, and the impact of sludge disposal to land.

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Generic Exposure - Industrial Setting

Exposure Scenario – Exposure resulting from industrial uses	
1. Title GES – Industrial downstream use of Copper sulphate	
Life cycle	Use (industrial) stage of copper sulphate
Free short title	Generic downstream industrial use of copper sulphate
Systematic title based on use descriptor	SU: SU3 – Industrial use PROC: 1, 2, 3, 4, 5, 7, 8a, 8b, 9, 10, 13, 14, 15, 17, 22, 23, 24, 25 [identified] PC: Various/not applicable AC: Not applicable ERC: 2, 3, 4, 5, 6a, 6b, 6d, 7, 8a*, 8c-e*, 10a*, 11a* [identified; *Wide dispersive use] spERC: F, U [where applicable]
Processes, tasks, activities covered (workers)	Downstream use of Copper sulphate All possible processes, tasks and activities described by the selected PROCs
Copper sulphate is widely used within downstream industrial processes, which are covered within this generic exposure scenario.	
2. Exposure scenario	
2.1 Contributing scenario (1) Controlling environmental exposure for all industrial DU of Copper sulphate [E-GES-DU1.0/2.0/1.1[ERC/spERC]/2.1[ERC/spERC]]	
Environmental related free short title	Generic exposure of the environment from the industrial DU of Copper sulphate
Assessment Method	Predicted (modelled) local and regional (measured) concentrations of copper are used for calculation of the PEC – Tools available: EUSES 2.0 / Suitable scaling tools
Product characteristics	
GENERIC Exposure: All forms have been investigated where applicable.	
Frequency and duration of use	
Intermittent (used < 12 times per year for not more than 24 h) or continuous use/release. GENERIC Exposure: 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	
GENERIC Exposure: Default for generic scenario: 18,000 m3/d, unless specified otherwise.	
Other given operational conditions affecting environmental exposure	
GENERIC Exposure: no operational conditions specified all wastewater emissions are based on ERC/spERC data.	
Technical conditions and measures at process level (source) to prevent release	
GENERIC Exposure: no operational conditions specified all wastewater emissions are based on ERC/spERC data.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
GENERIC Exposure assumptions: **Air:** 0.4% emission assumed irrespective of ERC. This value is taken from the worst-case available metal spERCs (Use of metals and metal compounds in metallic coating v1.1 Arche consultancy). This approach has been adopted due to negligible volatility of copper. The default ERC values for air emissions are unreasonably high. **Waste water :** Either; - No release to water, or - Release as dictated by appropriate ERC or spERC (see Section 2.1.1 for specific % releases). **Soil:** No significant direct releases assumed. However, where a municipal STP is used emissions via sewage sludge need to be taken into account. **Wide dispersive use**: In relation to releases to water, the scenario for both indoor and outdoor wide dispersive uses is based on the assumption that they occur in the urban infrastructure, are collected in a central public sewage system and are then treated by an STP. For outdoor uses, this scenario can be considered a reasonable worst case. To assume that all releases occur on a paved surface of an urban infrastructure and are collected in a sewage system may be considered overly conservative, but this is balanced by the assumption that all releases to water are treated in an STP. Direct releases to air and soil are not considered in the wide dispersive use scenario.	
Organisational measures to prevent /limit release from site	
GENERIC Exposure: no operational conditions specified all wastewater emissions are based on ERC/spERC data.	

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Conditions and measures related to municipal sewage treatment plant	
GENERIC Exposure assumptions: In cases where applicable: the default size has been used.	
Conditions and measures related to external treatment of waste for disposal	
GENERIC Exposure assumptions: no additional emissions to the environment via solid waste have been included in the assessment as disposal via appropriate waste streams have been assumed.	
Conditions and measures related to external recovery of waste	
GENERIC Exposure assumptions: no additional emissions to the environment via solid waste have been included in the assessment as disposal via appropriate waste streams have been assumed.	
Amounts used	
Amounts released in waste water should not result in environmental concentrations for each compartment that exceeds the established effect threshold value given in section 2.1.1. Information on associated default emissions to air and water is provided, based on specified default assumptions for RMM and the assumed characteristics of the receiving environment.	
2.1.1Generic guidance – ERC/spERC related: Technical conditions and measures to control emissions to the environment resulting from all industrial DU of Copper sulphate [E-GES-DU1.0/2.0; E-GES-DU1.1[ERC]; E-GES-WDU[ERC]; E-GES-DU2.1[spERC]]	
Effects and background data	
Effect threshold data [predicted no effect concentration (PNEC) data in the relevant environmental compartments cannot exceed these levels]	
Micro-organisms in STP (mg Cu L^{-1})	0.23
Freshwater aquatic (mg Cu L^{-1})	0.0078
Freshwater sediment (mg Cu kg dwt^{-1})	87.1
Marine water (mg Cu L^{-1})	0.0056
Marine sediment (mg Cu kg dwt^{-1})	676
Terrestrial compartment (mg Cu kg dwt^{-1})	64.6
Background level concentrations [existing copper concentrations to be add to the predicted environmental concentrations from processes to ensure the effect threshold concentration is not reached]	
Freshwater aquatic (mg Cu L^{-1})	0.0029
Freshwater sediment (mg Cu kg dwt^{-1})	0
Marine water (mg Cu L^{-1})	0.0011
Marine sediment (mg Cu kg dwt^{-1})	16.1
Terrestrial compartment (mg Cu kg dwt^{-1})	24.4
For individual assessments the default release data are available below in 2.1.1.1.	
2.1.1.1 Local site specific point source assessment	
E-GES-DU1.0/2.0	
Emissions covered: Tier 1 (ERC codes) Tier 2 (spERC) - No waste water releases	
Environmental Release Code	**ANY**
Life cycle stage (LCS)	Formulation/Use
Type of use in LCS	Any
Default release to air from process [%]	0.004
Default release to water from process [%]	0
Default release to soil from process [%]	0
Maximum off-site emission (via air) = 0.004% of total copper use as copper sulphate	
E-GES-DU1.1	
Emissions covered: Tier 1 (ERC codes) – waste water emission via STP [On-site WWTP can be introduced where applicable (used to reduce emission % further) but use of a sewage treatment plant (STP) presents a worst-case approach, as this allows for an assessment of risk to STP microorganisms, and the impact of sludge disposal to land.**]**	
Environmental Release Code	**ERC 2**
Life cycle stage (LCS)	Formulation
Type of use in LCS	Not included into matrix
Default release to water from process [%]	2
Environmental Release Code	**ERC 3**
Life cycle stage (LCS)	Formulation
Type of use in LCS	Formulation in materials

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Default release to water from process [%]	0.2
Environmental Release Code	**ERC 4**
Life cycle stage (LCS)	Use
Type of use in LCS	Processing aid
Default release to water from process [%]	100**
Environmental Release Code	**ERC 5**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use resulting in inclusion into or onto a matrix
Default release to water from process [%]	50
Environmental Release Code	**ERC 6a**
Life cycle stage (LCS)	Use
Type of use in LCS	Intermediate
Default release to water from process [%]	2
Environmental Release Code	**ERC 6b**
Life cycle stage (LCS)	Use
Type of use in LCS	Reactive processing aid
Default release to water from process [%]	5
Environmental Release Code	**ERC 6d**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers
Default release to water from process [%]	0.005
Environmental Release Code	**ERC 7**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use of substances in closed systems
Default release to water from process [%]	5

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Environmental Release Code	ERC 12a
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial processing of articles with abrasive techniques (low releases)
Default release to water from process [%]	2.5

Maximum off-site copper emission via water

Using the above information regarding emission factors and controls, the maximum off-site copper emission has been calculated to be either:

1. 0.8575 kg Cu/d assuming connection to a municipal STP and receiving water with a default flow rate of 18000 m^3/d (dilution factor of 10), or
2. 0.6174 kg Cu/d assuming direct release to receiving water [following on-site treatment] with a default flow rate of 18000 m^3/d (dilution factor of 10).

These values are intended to be illustrative. DU should confirm that they can support the environmental releases from their processes with the necessary monitoring and scaling calculations.

2.1.1.2 Wide dispersive use assessment

E-GES-WDU1.1

Emissions covered: Tier 1 (ERC codes) – wide dispersive uses

It has not been possible to derive maximum allowable emissions for individual wide dispersive uses of copper sulphate. However, measured region-specific PEC data available for STP effluents from 3 EU countries (Belgium, the Netherlands and UK) range between 0.011 and 0.054 mg total Cu/l. The highest PEC of 0.054 mg total Cu/l, reported in the UK, was shown to be equivalent to 0.008 mg dissolved Cu/l.

These data suggest that emissions to receiving water courses with dilutions ≥10 ≤15 would be sufficient to remove any concern for the aquatic environment as a result of wide dispersive uses of products containing Copper sulphate. This approach and these data have been presented and accepted within the VRA (2008) for the consideration of all copper inputs across the EU.

For individual assessments the default release data are available below.

Environmental Release Code	ERC 8a
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use of processing aids in open systems
Default release to water from process [%]	100
Environmental Release Code	**ERC 8b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use reaction on use in open systems
Default release to water from process [%]	2
Environmental Release Code	**ERC 8c**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	1
Environmental Release Code	**ERC 8d**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use of processing aids in open systems
Default release to water from process [%]	100
Environmental Release Code	**ERC 8e**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use reaction on use in open systems
Default release to water from process [%]	2
Environmental Release Code	**ERC 8f**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems

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Default release to water from process [%]	1
Environmental Release Code	**ERC 9a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use of processing aids in closed systems
Default release to water from process [%]	N/A
Environmental Release Code	**ERC 9b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive outdoor use of processing aids in closed systems
Default release to water from process [%]	5
Environmental Release Code	**ERC 10a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive outdoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	0.16
Environmental Release Code	**ERC 10b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	100
Environmental Release Code	**ERC 11a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	0.05
Environmental Release Code	**ERC 11b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	100
E-GES-DU2.1	
Emissions covered: Tier 2 (spERC codes) – waste water emission via STP [On-site WWTP can be introduced where applicable (used to reduce emission % further) but use of a sewage treatment plant (STP) presents a worst-case approach, as this allows for an assessment of risk to STP microorganisms, and the impact of sludge disposal to land.**]**	
Environmental Release Code	**spERC Metal Compound Formulation**
Life cycle stage (LCS)	Formulation
Type of use in LCS	Formulating industries: *catalyst*, glass, pigments, paints, coatings, plastics, rubber and stabilisers, water treatment chemicals
Default release to air from process [%]	0.004
Default release to water from process [%]	0.5
Default release to soil from process [%]	0
Environmental Release Code	**spERC Metal Compound Use**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use of metal compounds
Default release to air from process [%]	0.004
Default release to water from process [%]	0.1
Default release to soil from process [%]	0.6
Maximum off-site copper emission via water	

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Using the above information regarding emission factors and controls, the maximum off-site copper emission has been calculated to be either:

1. 0.8575 kg Cu/d assuming connection to a municipal STP and receiving water with a default flow rate of 18000 m^3/d (dilution factor of 10), or
2. 0.6174 kg Cu/d assuming direct release to receiving water [following on-site treatment] with a default flow rate of 18000 m^3/d (dilution factor of 10).

These examples are intended to be illustrative. DU should confirm that they can support the environmental releases from their processes with the necessary monitoring and scaling calculations.

2.2 Contributing scenario (2) Controlling of workers exposure for all industrial DU of Copper sulphate [W-GES-DU(High, Med, Low, Liquid)[PROC]]

Workers related free short title	Generic exposure for workers exposed to Copper sulphate
Assessment Method	Estimation of exposure based on predicted data using MEASE
Product characteristic	
Solid (High, medium and low dustiness) and liquid (aqueous solution)	
Amounts used	
Varying (risk limited by exposure not quantities)	
Frequency and duration of use/exposure	
Daily > 4 hours [Typically 8 hour shift]	
Human factors not influenced by risk management	
Respiration volume under conditions of use	10 m^3/8 h shift
Room size and ventilation rate	Room size is not specified as it is the breathable portion of air which is used to define the exposure and ventilation is used as an exposure modifier where LEV is required. See Section 2.2.1.
Area of skin contact with the substance under conditions of use	240 cm^2
Body weight	70 kg
DNEL inhalation	1 mg/m^3
DNEL dermal solids	9566.9 mg/day
DNEL dermal sol/slurry	956.9 mg/day
Other given operational conditions affecting workers exposure	
Worst case assumptions from MEASE: Wide dispersive use, direct handling and extensive contact	
Technical conditions and measures at process level (source) to prevent release	
Activity controlled in accordance with PROC descriptor	
Technical conditions and measures to control dispersion from source towards the worker	
Specific details to be added by Supplier/DU (see Section 2.2.1 for generic advice)	
Organisational measures to prevent /limit releases, dispersion and exposure	
Specific details to be added by Supplier/DU (good hygiene training and supervision assumed)	
Conditions and measures related to personal protection, hygiene and health evaluation	
Specific details to be added by Supplier/DU (see Section 2.2.1 for generic advice)	

2.2.1 PROC related: Technical conditions and measures to control dispersion from source towards the worker and measures related to personal protection, hygiene and health evaluation [W-GES-DU(High, Med, Low, Liquid)[PROC]]

PROC 1

Activities covered: Use of the substances in high integrity contained system where little potential exists for exposures, e.g. any sampling via closed loop systems

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	No	No
W-GES-DU(Med)		Medium	No	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 2

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Activities covered: Continuous process but where the design philosophy is not specifically aimed at minimizing emissions It is not high integrity and occasional expose will arise e.g. through maintenance, sampling and equipment breakages

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	No
W-GES-DU(Med)		Medium	No	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 3

Activities covered: Batch manufacture of a chemical or formulation where the predominant handling is in a contained manner, e.g. through enclosed transfers, but where some opportunity for contact with chemicals occurs, e.g. through sampling

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	No
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 4

Activities covered: Use in batch manufacture of a chemical where significant opportunity for exposure arises, e.g. during charging, sampling or discharge of material, and when the nature of the design is likely to result in exposure

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes AFP = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 5

Activities covered: Manufacture or formulation of chemical products or articles using technologies related to mixing and blending of solid or liquid materials, and where the process is in stages and provides the opportunity for significant contact at any stage

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes AFP = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 7

Activities covered: Air dispersive techniques
Spraying for surface coating, adhesives, polishes/cleaners, air care products, sandblasting
Substances can be inhaled as aerosols. The energy of the aerosol particles may require advanced exposure controls; in case of coating, overspray may lead to waste water and waste.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(Liquid)	Liquid		Yes	Yes AFP = 4

PROC 8a

Activities covered: Sampling, loading, filling, transfer, dumping, bagging in non- dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustine	High	Yes	Yes AFP = 10
W-GES-DU(Med)		Medium	Yes	No

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W-GES-DU(Low)	ss]	Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 8b

Activities covered: Sampling, loading, filling, transfer, dumping, bagging in dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes AFP = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 9

Activities covered: Filling lines specifically designed to both capture vapour and aerosol emissions and minimise spillage.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes AFP = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 10

Activities covered: Low energy spreading of e.g. coatings Including cleaning of surfaces. Substance can be inhaled as vapours, skin contact can occur through droplets, splashes, working with wipes and handling of treated surfaces.

GES	Physical form	Worker protection required	
		LEV	PPE
W-GES-DU(Liquid)	Liquid	No	No

PROC 13

Activities covered: Immersion operations
Treatment of articles by dipping, pouring, immersing, soaking, washing out or washing in substances; including cold formation or resin type matrix. Includes handling of treated objects (e.g. after dying, plating,).
Substance is applied to a surface by low energy techniques such as dipping the article into a bath or pouring a preparation onto a surface.

GES	Physical form	Worker protection required	
		LEV	PPE
W-GES-DU(Liquid)	Liquid	No	No

PROC 14

Activities covered: Processing of preparations and/or substances (liquid and solid) into preparations or articles. Substances in the chemical matrix may be exposed to elevated mechanical and/or thermal energy conditions. Exposure is predominantly related to volatiles and/or generated fumes, dust may be formed as well.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes AFP = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No

PROC 15

Activities covered: Use of substances at small scale laboratory (< 1 l or 1 kg present at workplace). Larger laboratories and R+D installations should be treated as industrial processes.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustine	High	Yes	No
W-GES-DU(Med)		Medium	No	No

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W-GES-DU(Low)	ss]	Low	No	No
W-GES-DU(Liquid)	Liquid		No	No
PROC 17				
Activities covered: Lubrication at high energy conditions (temperature, friction) between moving parts and substance; significant part of process is open to workers. The metal working fluid may form aerosols or fumes due to rapidly moving metal parts.				
GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
W-GES-DU(Liquid)	Liquid		No	No
PROC 19				
Activities covered: Addresses occupations where intimate and intentional contact with substances occurs without any specific exposure controls other than PPE.				
GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
W-GES-DU(High)	Solid [Dustiness]	High	No	Yes AFP = 40
W-GES-DU(Med)		Medium	No	Yes AFP = 10
W-GES-DU(Low)		Low	No	No
W-GES-DU(Liquid)	Liquid		No	No
PROC 20				
Activities covered: Motor and engine oils, brake fluids Also in these applications, the lubricant may be exposed to high energy conditions and chemical reactions may take place during use. Exhausted fluids need to be disposed of as waste. Repair and maintenance may lead to skin contact.				
GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
W-GES-DU(Liquid)	Liquid		No	No
PROC 21				
Activities covered: Manual cutting, cold rolling or assembly/disassembly of material/article (including metals in massive form), possibly resulting in the release of fibres, metal fumes or dust.				
GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
W-GES-DU(High)	Solid [Dustiness]	High	Yes	No
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	Yes	No
PROC 22				
Activities covered: Activities at smelters, furnaces, refineries, coke ovens. Exposure related to dust and fumes to be expected. Emission from direct cooling may be relevant.				
GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
W-GES-DU(High)	Solid [Dustiness]	High	Yes	No
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	Yes	No
PROC 23				
Activities covered: Sand and die casting, tapping and casting melted solids, dressing of melted solids, hot dip galvanising, raking of melted solids in paving. Exposure related to dust and fumes to be expected.				
GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
W-GES-DU(High)	Solid [Dustiness]	High	Yes	No
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	Yes	No
PROC 24				

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Activities covered: Substantial thermal or kinetic energy applied to substance (including metals in massive form) by hot rolling/forming, grinding, mechanical cutting, drilling or sanding. Exposure is predominantly expected to be to dust. Dust or aerosol emission as result of direct cooling may be expected.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	Yes	No

PROC 25

Activities covered: Transfer and handling of ores, concentrates, raw metal oxides and scrap; packaging, un-packaging, mixing/blending and weighing of metal powders or other minerals

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	No
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	Yes	No

PROC 25

Activities covered: Welding, soldering, gouging, brazing, flame cutting.

Exposure is predominantly expected to fumes and gases.

GES	Physical form		Worker protection required	
			LEV	PPE
W-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 4
W-GES-DU(Med)		Medium	Yes	No
W-GES-DU(Low)		Low	Yes	No

3. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment:

Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool).

Scaling of the release to air and water environment includes: Refining of the release factor to air and waste water and/or the efficiency of the air filter and waste water treatment facility.

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It should be noted that the maximum allowable emissions to wastewater presented in this document have been modelled on the basis of standardised (default) assumptions regarding the efficiency of municipal sewage treatment plants (where present) and dilution/flow rate of receiving waters. These standardised assumptions may not accurately reflect the conditions that prevail at a particular site. As such, the information presented in this document should be regarded as a guidance tool only. It remains the responsibility of the user to ensure that a compound is used safely within the context of their site and in full consultation with the relevant local authorities.

Workers – Industrial:

Scaling tool: MEASE - Occupational Exposure Assessment Tool for REACH (free download: http://www.ebrc.de/ebrc/ebrc-mease.php).

Scaling considering duration and frequency of use: Collect process occupational exposure monitoring data.

It should be noted that the evaluation of worker safety presented in this document is based on standardised (default) assumptions on levels of exposure associated with generic processes, the behaviour of a compound in a particular working environment and the presumed efficiency of Risk Management Measures (e.g. LEV; RPE). These standardised assumptions may not accurately reflect the conditions that prevail within a specific workplace. As such, the information presented in this document should be regarded as a guidance tool only. It remains the responsibility of the user to ensure that a compound is used safely within the context of their site and in full consultation with the relevant local authorities.

Predictions for inhalation exposure in the workplace may be further refined using the modelling approach set out in the copper Risk Assessment Report (2008), Chapter 4.1.2, Human Health Effects.

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Generic Exposure - Professional Setting

Exposure scenario – Exposure resulting from professional uses	
1. Title GES – Professional downstream use of Copper sulphate	
Life cycle	Use stage of Copper sulphate
Free short title	Generic professional use of Copper sulphate
Systematic title based on use descriptor	SU: SU22 – Professional use PC: Various PROC: 1, 2, 3, 4, 5, 8a, 8b, 9, 10, 11, 13, 15, 17, 19, 20, 21, 25, 26. [identified] ERC: 2, 3, 4, 5, 6a, 6b, 8a-f*, 9a*, 9b*, 10a*, 11a* [identified; *Wide dispersive use] spERC: F, U [where applicable]
Processes, tasks, activities covered (workers)	Downstream use of Copper sulphate All possible processes, tasks and activities described by the selected PROCs
2. Exposure scenario	
2.1 Contributing scenario (1) Controlling environmental exposure for all professional DU of Copper sulphate [[E-GES-DU1.0/2.0; E-GES-DU1.1[ERC]; E-GES-WDU[ERC]; E-GES-DU2.1[spERC]]]	
Environmental related free short title	Generic exposure of the environment from the professional DU of Copper sulphate
Assessment Method	Predicted (modelled) local and regional (measured) concentrations of copper are used for calculation of the PEC – Tools available: EUSES 2.0 / Suitable scaling tools
Product characteristics	
Purity: *To be added by Supplier/DU* Form: Solid (High, medium and low dustiness) or liquid (aqueous solution) GENERIC Exposure: All forms have been investigated where applicable.	
Frequency and duration of use	
Intermittent (used < 12 times per year for not more than 24 h) or continuous use/release GENERIC Exposure: Continuous production is assumed as a worst case. It is possible that use is not continuous; this has to be considered when estimating exposure.	

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Environment factors not influenced by risk management
Dilution factor of 10, based on flow rate of receiving surface water (m3/d, a default of 18,000 m3/d is assumed for a standard EU town. please note: the default flow rate will be rarely changeable for downstream uses). GENERIC Exposure: Default for generic scenario: 18,000 m3/d, unless specified otherwise.
Other given operational conditions affecting environmental exposure
GENERIC Exposure: no operational conditions specified all wastewater emissions are based on ERC/spERC data.
Technical conditions and measures at process level (source) to prevent release
GENERIC Exposure: no operational conditions specified all wastewater emissions are based on ERC/spERC data.
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
GENERIC Exposure assumptions: **Air:** 0.4% emission assumed irrespective of ERC. This value is taken from the worst-case available metal spERCs (Use of metals and metal compounds in metallic coating v1.1 Arche consultancy). This approach has been adopted due to negligible volatility of copper. The default ERC values for air emissions are unreasonably high. **Waste water :** Either; - No release to water, or - Release as dictated by appropriate ERC or spERC (see Section 2.1.1 for specific % releases). **Soil:** No significant direct releases assumed. However, where a municipal STP is used emissions via sewage sludge need to be taken into account. **Wide dispersive use**: In relation to releases to water, the scenario for both indoor and outdoor wide dispersive uses is based on the assumption that they occur in the urban infrastructure, are collected in a central public sewage system and are then treated by an STP. For outdoor uses, this scenario can be considered a reasonable worst case. To assume that all releases occur on a paved surface of an urban infrastructure and are collected in a sewage system may be considered overly conservative, but this is balanced by the assumption that all releases to water are treated in an STP. Direct releases to air and soil are not considered in the wide dispersive use scenario.
Organisational measures to prevent /limit release from site
GENERIC Exposure: no operational conditions specified all wastewater emissions are based on ERC/spERC data.
Conditions and measures related to municipal sewage treatment plant
GENERIC Exposure assumptions: In cases where applicable: the default size has been used.

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Conditions and measures related to external treatment of waste for disposal

GENERIC Exposure assumptions: no additional emissions to the environment via solid waste have been included in the assessment as disposal via appropriate waste streams have been assumed.

Conditions and measures related to external recovery of waste

GENERIC Exposure assumptions: no additional emissions to the environment via solid waste have been included in the assessment as disposal via appropriate waste streams have been assumed.

Amounts used

Amounts released in waste water should not result in environmental concentrations for each compartment that exceeds the established effect threshold value given in section 2.1.1. Information on associated default emissions to air and water is provided, based on specified default assumptions for RMM and the assumed characteristics of the receiving environment.

2.1.1Generic guidance – ERC/spERC related: Technical conditions and measures to control emissions to the environment resulting from all professional DU of Copper sulphate [E-GES-DU1.0/2.0; E-GES-DU1.1[ERC]; E-GES-WDU[ERC]; E-GES-DU2.1[spERC]]

Effects and background data

Effect threshold data [predicted no effect concentration (PNEC) data in the relevant environmental compartments cannot exceed these levels]

Micro-organisms in STP (mg Cu L^{-1})	0.23
Freshwater aquatic (mg Cu L^{-1})	0.0078
Freshwater sediment (mg Cu kg dwt^{-1})	87.1
Marine water (mg Cu L^{-1})	0.0056
Marine sediment (mg Cu kg dwt^{-1})	676
Terrestrial compartment (mg Cu kg dwt^{-1})	64.6

Background level concentrations [existing copper concentrations to be add to the predicted environmental concentrations from processes to ensure the effect threshold concentration is not reached]

Freshwater aquatic (mg Cu L^{-1})	0.0029
Freshwater sediment (mg Cu kg dwt^{-1})	0
Marine water (mg Cu L^{-1})	0.0011
Marine sediment (mg Cu kg dwt^{-1})	16.1
Terrestrial compartment (mg Cu kg dwt^{-1})	24.4

For individual assessments the default release data are available below in 2.1.1.1.

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2.1.1.1 Local site specific point source assessment	
E-GES-DU1.0/2.0	
Emissions covered: Tier 1 (ERC codes) Tier 2 (spERC) - No waste water releases	
Environmental Release Code	**ANY**
Life cycle stage (LCS)	Formulation/Use
Type of use in LCS	Any
Default release to air from process [%]	0.004
Default release to water from process [%]	0
Default release to soil from process [%]	0
Maximum off-site emission (via air) = 0.004% of total copper use as copper sulphate	
E-GES-DU1.1	
Emissions covered: Tier 1 (ERC codes) – waste water emission via STP [On-site WWTP can be introduced where applicable (used to reduce emission % further) but use of a sewage treatment plant (STP) presents a worst-case approach, as this allows for an assessment of risk to STP microorganisms, and the impact of sludge disposal to land.**]**	
Environmental Release Code	**ERC 2**
Life cycle stage (LCS)	Formulation
Type of use in LCS	Not included into matrix
Default release to water from process [%]	2
Environmental Release Code	**ERC 3**
Life cycle stage (LCS)	Formulation
Type of use in LCS	Formulation in materials
Default release to water from process [%]	0.2
Environmental Release Code	**ERC 4**
Life cycle stage (LCS)	Use
Type of use in LCS	Processing aid
Default release to water from process [%]	100**
Environmental Release Code	**ERC 5**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use resulting in inclusion into or onto a matrix

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Default release to water from process [%]	50
Environmental Release Code	**ERC 6a**
Life cycle stage (LCS)	Use
Type of use in LCS	Intermediate
Default release to water from process [%]	2
Environmental Release Code	**ERC 6b**
Life cycle stage (LCS)	Use
Type of use in LCS	Reactive processing aid
Default release to water from process [%]	5
Environmental Release Code	**ERC 6d**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers
Default release to water from process [%]	0.005
Environmental Release Code	**ERC 7**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use of substances in closed systems
Default release to water from process [%]	5
Environmental Release Code	**ERC 12a**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial processing of articles with abrasive techniques (low releases)
Default release to water from process [%]	2.5
Maximum off-site copper emission via water	

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Using the above information regarding emission factors and controls, the maximum off-site copper emission has been calculated to be either;

1. 0.8575 kg Cu/d assuming connection to a municipal STP and receiving water with a default flow rate of 18000 m^3/d (dilution factor of 10).
2. 0.6174 kg Cu/d assuming direct release to receiving water [following on-site treatment] with a default flow rate of 18000 m^3/d (dilution factor of 10).

These examples are intended to be illustrative. DU should confirm that they can support the environmental releases from their processes with the necessary monitoring and scaling calculations.

2.1.1.2 Wide dispersive use assessment

E-GES-WDU1.1

Emissions covered: Tier 1 (ERC codes) – wide dispersive uses

It has not been possible to derive maximum allowable emissions for individual wide dispersive uses of copper sulphate. However, measured region-specific PEC data available for STP effluents from 3 EU countries (Belgium, the Netherlands and UK) range between 0.011 and 0.054 mg total Cu/l. The highest PEC for the STP of 0.054 mg total Cu/l, reported in the UK, was shown to be equivalent to 0.008 mg dissolved Cu/l.

These data suggest that emissions to receiving water courses with dilutions ≥10 ≤15 would be sufficient to remove any concern for the aquatic environment as a result of wide dispersive uses of products containing Copper sulphate.

This approach and these data have been presented and accepted within the VRA (2008) for the consideration of all copper inputs across the EU.

For individual assessments the default release data are available below.

Environmental Release Code	**ERC 8a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use of processing aids in open systems
Default release to water from process [%]	100
Environmental Release Code	**ERC 8b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use reaction on use in open systems
Default release to water from process [%]	2

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Environmental Release Code	**ERC 8c**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	1
Environmental Release Code	**ERC 8d**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use of processing aids in open systems
Default release to water from process [%]	100
Environmental Release Code	**ERC 8e**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use reaction on use in open systems
Default release to water from process [%]	2
Environmental Release Code	**ERC 8f**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	1
Environmental Release Code	**ERC 9a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use of processing aids in closed systems
Default release to water from process [%]	N/A
Environmental Release Code	**ERC 9b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive outdoor use of processing aids in closed systems
Default release to water from process [%]	5
Environmental Release Code	**ERC 10a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive outdoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	0.16

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Environmental Release Code	**ERC 10b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	100
Environmental Release Code	**ERC 11a**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	0.05
Environmental Release Code	**ERC 11b**
Life cycle stage (LCS)	Wide dispersive use
Type of use in LCS	Wide dispersive indoor use resulting in inclusion into or onto a matrix in open systems
Default release to water from process [%]	100

E-GES-DU2.1

Emissions covered: Tier 2 (spERC codes) – waste water emission via STP [On-site WWTP can be introduced where applicable (used to reduce emission % further) but use of a sewage treatment plant (STP) presents a worst-case approach, as this allows for an assessment of risk to STP microorganisms, and the impact of sludge disposal to land.**]**

Environmental Release Code	**spERC Metal Compound Formulation**
Life cycle stage (LCS)	Formulation
Type of use in LCS	Formulating industries: *catalyst*, glass, pigments, paints, coatings, plastics, rubber and stabilisers, water treatment chemicals
Default release to air from process [%]	0.004
Default release to water from process [%]	0.5
Default release to soil from process [%]	0
Environmental Release Code	**spERC Metal Compound Use**
Life cycle stage (LCS)	Use
Type of use in LCS	Industrial use of metal compounds
Default release to air from process [%]	0.004
Default release to water from process [%]	0.1
Default release to soil from process [%]	0.6

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Maximum off-site copper emission via water
Using the above information regarding emission factors and controls, the maximum off-site copper emission has been calculated to be either; 1. 0.8575 kg Cu/d assuming connection to a municipal STP and receiving water with a default flow rate of 18000 m^3/d (dilution factor of 10), or 2. 0.6174 kg Cu/d assuming direct release to receiving water [following on-site treatment] with a default flow rate of 18000 m^3/d (dilution factor of 10). This is only intended as an example and DU should ensure that they check that they can support the environmental releases from their processes with the necessary monitoring and scaling calculations.

2.2 Contributing scenario (2) Controlling of workers exposure for all professional DU of Copper sulphate [W-GES-DU(High, Med, Low, Liquid)[PROC]]	
Workers related free short title	Generic exposure for professional workers exposed to Copper sulphate
Assessment Method	Estimation of exposure based on predicted data using MEASE
Product characteristic	
Solid (High, medium and low dustiness) and liquid (aqueous solution)	
Amounts used	
Varying (risk limited by exposure not quantities)	
Frequency and duration of use/exposure	
Daily > 4 hours [Typically 8 hour shift]	
Human factors not influenced by risk management	
Respiration volume under conditions of use	10 m^3/8 h shift
Room size and ventilation rate	Room size is not specified as it is the breathable portion of air which is used to define the exposure and ventilation is used as an exposure modifier where LEV is required. See Section 2.2.1.
Area of skin contact with the substance under conditions of use	240 cm^2
Body weight	70 kg
DNEL inhalation	1 mg/m^3
DNEL dermal solids	9566.9 mg/day
DNEL dermal sol/slurry	956.9 mg/day

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Other given operational conditions affecting workers exposure
Worst case assumptions from MEASE : Wide dispersive use, direct handling and extensive contact
Technical conditions and measures at process level (source) to prevent release
Activity controlled in accordance with PROC descriptor
Technical conditions and measures to control dispersion from source towards the worker
Specific details to be added by Supplier/ DU (see Section 2.2.1 for generic advice)
Organisational measures to prevent /limit releases, dispersion and exposure
Specific details to be added by Supplier/DU (good hygiene training and supervision assumed)
Conditions and measures related to personal protection, hygiene and health evaluation
Specific details to be added by Supplier/ DU (see Section 2.2.1 for generic advice)

2.2.1 Technical conditions and measures to control dispersion from source towards the worker and measures related to personal protection, hygiene and health evaluation [PW-GES-DU-High, Med, Low, Liquid]

PROC 1

Activities covered: Use of the substances in high integrity contained system where little potential exists for exposures, e.g. any sampling via closed loop systems

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	No	No
PW-GES-DU(Med)		Medium	No	No
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 2

Activities covered: Continuous process but where the design philosophy is not specifically aimed at minimizing emissions It is not high integrity and occasional expose will arise e.g. through maintenance, sampling and equipment breakages

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	No
PW-GES-DU(Med)		Medium	Yes	No

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PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 3

Activities covered: Batch manufacture of a chemical or formulation where the predominant handling is in a contained manner, e.g. through enclosed transfers, but where some opportunity for contact with chemicals occurs, e.g. through sampling

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	No
PW-GES-DU(Med)		Medium	Yes	No
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 4

Activities covered: Use in batch manufacture of a chemical where significant opportunity for exposure arises, e.g. during charging, sampling or discharge of material, and when the nature of the design is likely to result in exposure

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 10
PW-GES-DU(Med)		Medium	Yes	No
PW-GES-DU(Low)		Low	Yes	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 5

Activities covered: Manufacture or formulation of chemical products or articles using technologies related to mixing and blending of solid or liquid materials, and where the process is in stages and provides the opportunity for significant contact at any stage

GES	**Physical form**	**Worker protection required**	
		LEV	**PPE**

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PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 10
PW-GES-DU(Med)		Medium	Yes	No
PW-GES-DU(Low)		Low	Yes	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 8a

Activities covered: Sampling, loading, filling, transfer, dumping, bagging in non- dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 10
PW-GES-DU(Med)		Medium	Yes	No
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 8b

Activities covered: Sampling, loading, filling, transfer, dumping, bagging in dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 4
PW-GES-DU(Med)		Medium	Yes	No
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 9

Activities covered: Filling lines specifically designed to both capture vapour and aerosol emissions and minimise spillage.

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 4
PW-GES-DU(Med)		Medium	Yes	No

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PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 10

Activities covered: Low energy spreading of e.g. coatings Including cleaning of surfaces. Substance can be inhaled as vapours, skin contact can occur through droplets, splashes, working with wipes and handling of treated surfaces.

GES	Physical form	Worker protection required	
		LEV	PPE
PW-GES-DU(Liquid)	Liquid	No	No

PROC 11

Activities covered: Air dispersive techniques.

Spraying for surface coating, adhesives, polishes/cleaners, air care products, sandblasting.

Substances can be inhaled as aerosols. The energy of the aerosol particles may require advanced exposure controls.

GES	Physical form	Worker protection required	
		LEV	PPE
PW-GES-DU(Liquid)	Liquid	Yes	Yes APF = 10

PROC 13

Activities covered: Immersion operations

Treatment of articles by dipping, pouring, immersing, soaking, washing out or washing in substances; including cold formation or resin type matrix. Includes handling of treated objects (e.g. after dying, plating,).

Substance is applied to a surface by low energy techniques such as dipping the article into a bath or pouring a preparation onto a surface.

GES	Physical form	Worker protection required	
		LEV	PPE
PW-GES-DU(Liquid)	Liquid	No	No

PROC 14

Activities covered: Processing of preparations and/or substances (liquid and solid) into preparations or articles. Substances in the chemical matrix may be exposed to elevated mechanical and/or thermal energy conditions. Exposure is predominantly related to volatiles and/or generated fumes, dust may be formed as well.

GES	Physical form	Worker protection required

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			LEV	PPE
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 10
PW-GES-DU(Med)		Medium	No	No
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 15

Activities covered: Use of substances at small scale laboratory (< 1 l or 1 kg present at workplace). Larger laboratories and R+D installations should be treated as industrial processes.

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	No
PW-GES-DU(Med)		Medium	No	No
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 17

Activities covered: Lubrication at high energy conditions (temperature, friction) between moving parts and substance; significant part of process is open to workers.

The metal working fluid may form aerosols or fumes due to rapidly moving metal parts.

GES	**Physical form**	**Worker protection required**	
		LEV	**PPE**
PW-GES-DU(Liquid)	Liquid	Yes	No

PROC 19

Activities covered: Addresses occupations where intimate and intentional contact with substances occurs without any specific exposure controls other than PPE.

GES	**Physical form**		**Worker protection required**	
			LEV	**PPE**
PW-GES-DU(High)	Solid [Dustiness]	High	No	Yes APF = 40 [exposure time <4h/d]

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PW-GES-DU(Med)		Medium	No	Yes APF = 10
PW-GES-DU(Low)		Low	No	No
PW-GES-DU(Liquid)	Liquid		No	No

PROC 20

Activities covered: Motor and engine oils, brake fluids Also in these applications, the lubricant may be exposed to high energy conditions and chemical reactions may take place during use. Exhausted fluids need to be disposed of as waste. Repair and maintenance may lead to skin contact.

GES	Physical form	Worker protection required	
		LEV	PPE
PW-GES-DU(Liquid)	Liquid	No	No

PROC 21

Activities covered: Manual cutting, cold rolling or assembly/disassembly of material/article (including metals in massive form), possibly resulting in the release of fibres, metal fumes or dust.

GES	Physical form		Worker protection required	
			LEV	PPE
PW-GES-DU(Low)	Solid [Dustiness]	Low	No	No

PROC 22

Activities covered: Welding, soldering, gouging, brazing, flame cutting.

Exposure is predominantly expected to fumes and gases.

GES	Physical form		Worker protection required	
			LEV	PPE
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 4
PW-GES-DU(Med)		Medium	Yes	Yes APF = 4
PW-GES-DU(Low)		Low	Yes	Yes APF = 4

PROC 25

Activities covered: Welding, soldering, gouging, brazing, flame cutting.

Exposure is predominantly expected to fumes and gases.

GES	Physical form	Worker protection required

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			LEV	PPE
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	No
PW-GES-DU(Med)		Medium	Yes	No
PW-GES-DU(Low)		Low	Yes	No

PROC 26

Activities covered: Transfer and handling of ores, concentrates, raw metal oxides and scrap; packaging, un-packaging, mixing/blending and weighing of metal powders or other minerals.

GES	Physical form		Worker protection required	
			LEV	PPE
PW-GES-DU(High)	Solid [Dustiness]	High	Yes	Yes APF = 10
PW-GES-DU(Med)		Medium	Yes	Yes APF = 4
PW-GES-DU(Low)		Low	Yes	No

3. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment:

Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool).

Scaling of the release to air and water environment includes: Refining of the release factor to air and waste water and/or the efficiency of the air filter and waste water treatment facility.

It should be noted that the maximum allowable emissions to wastewater presented in this document have been modelled on the basis of standardised (default) assumptions regarding the efficiency of municipal sewage treatment plants (where present) and dilution/flow rate of receiving waters. These standardised assumptions may not accurately reflect the conditions that prevail at a particular site. As such, the information presented in this document should be regarded as a guidance tool only. It remains the responsibility of the user to ensure that a compound is used safely within the context of their site and in full consultation with the relevant local authorities.

Workers - Professional:

Scaling tool: MEASE - Occupational Exposure Assessment Tool for REACH (free download: http://www.ebrc.de/ebrc/ebrc-mease.php).

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Scaling considering duration and frequency of use. Collect process occupational exposure monitoring data.

It should be noted that the evaluation of worker safety presented in this document is based on standardised (default) assumptions on levels of exposure associated with generic processes, the behaviour of a compound in a particular working environment and the presumed efficiency of Risk Management Measures (e.g. LEV; RPE). These standardised assumptions may not accurately reflect the conditions that prevail within a specific workplace. As such, the information presented in this document should be regarded as a guidance tool only. It remains the responsibility of the user to ensure that a compound is used safely within the context of their site and in full consultation with the relevant local authorities.

Predictions for inhalation exposure in the workplace may be further refined using the modelling approach set out in the copper Risk Assessment Report (2008), Chapter 4.1.2, Human Health Effects.