Section A5 Effectiveness against target organisms and intended uses

	PT 08	For all parts of the Community: 0.1–1.0 % calculated as elemental copper in the substrate to be protected (PT08) where 0.1% stands for vacuum pressure treatment and 1.0% stands for dipping application (refer to EN 599-1 resp. –2).
5.4	**Mode of action (including time delay) (IIA5.4)**	
5.4.1	**Mode of action**	Copper hydroxide acts by prevention of fungal infections. Upon contact with the fungicide layer the spores passively take up copper II cations which hinder their germination. Copper II cations have a high binding affinity to amino- and carboxyl-groups and therefore act on many sites in the fungal metabolism. They combine with the sulfhydryl groups of amino acids and with carboxyl groups of the cell or membrane proteins. These reactions are unspecific and varied. Metabolism is interrupted through inhibition of many enzyme reactions. Copper II cations compete with other metals and their derivatives in the cell through chelation. Amongst others the influence of copper II cations in the organism causes unspecific denaturation of proteins and enzymes. That is why it also acts as feeding and cell poison for insects.
5.4.2	**Time delay**	Not required since no conversion of the effective copper cations takes place in order to achieve the intended effects.
5.5	**Field of use envisaged (IIA5.5)**	
	MG02: Preservatives	Product type PT08 Use classes 1–4a
5.6	**User (IIA5.6)**	
	Industrial and professional	Wood protection by pre-treatment in industrial premises (vacuum pressure impregnation and professional dipping treatment)
	General public	Not envisaged
5.7	**Information on the occurrence or possible occurrence of the development of resistance and appropriate management strategies (IIA5.7)**	

Section A5 Effectiveness against target organisms and intended uses

5.7.1 Development of resistance	According to the mode of action of copper ions which functions by means of getting into contact with pathogen cell membranes there is no development of resistance to be expected. This assumption has been confirmed by the practical use of copper as a wood preservative during many decades, as there has never been reported any development of resistance from the target fungi. There are, however, a few fungal species showing tolerance towards copper. An overview, including information on the underlying mechanism is given in Table A5- 5~~Table A5- 5~~. Regarding target insects no formation of resistance has to be expected because of the wide alternation of generations (e.g. house longhorn beetle).
5.7.2 Management strategies	Application of wood preservatives generally takes place above the lethal level, therefore no formation of resistance within the alternation of generations is possible. Possibilities to control copper tolerant fungi are outlined in Table A5-5~~Table A5- 5~~.
5.8 Likely tonnage to be placed on the market per year (IIA5.8)	Estimated overall total market volume for Copper hydroxide in wood preservatives within EU: about [redacted] per year, including imported quantities. No biocidal uses other than for wood protection are thought to be of any significant value. Market volume for Copper hydroxide as active substance of plant protection products can be estimated to be at about [redacted] per year in EU.

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Section A5 **Effectiveness against target organisms and intended uses**

	Evaluation by Competent Authorities
	Use separate "evaluation boxes" to provide transparency as to the comments and views submitted
	EVALUATION BY RAPPORTEUR MEMBER STATE
Date	Oct the 15th, 2007 and October the 29th, 2009
Materials and methods	The list of data provided by the applicant is given in table A5-1 to table A5-5 X1: EN113 test on *Corisolus versicolor* not produced X2: EN117 test on termite not produced Trials provided do not meet EN 599 requirements. However, there are consistent data provided showing efficacy of copper against rot and soft fungi as well as wood borers and termites.
Conclusion	Applicant's claims are acceptable and applicant's version is adopted.
Reliability	2b and 2g (according to the Klimisch cotation)
Acceptability	Acceptable.
Remarks	Taking into account of the potential influence of the formulation on the efficacy, concentrations proposed of active substance copper in the wood treated (0,1% for vacuum pressure and 1% for dipping application) should be considered as an indicator. No individual summary studies were provided by the applicant for this section but the Table A5- 1 to Table A5- 5 give summary data on the effectiveness of copper for the 30 studies.
	COMMENTS FROM ...
Date	*Give date of comments submitted*
Results and discussion	*Discuss additional relevant discrepancies referring to the (sub)heading numbers and to applicant's summary and conclusion.* *Discuss if deviating from view of rapporteur member state*
Conclusion	*Discuss if deviating from view of rapporteur member state*
Reliability	*Discuss if deviating from view of rapporteur member state*
Acceptability	*Discuss if deviating from view of rapporteur member state*
Remarks	

Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
CCA (chromated Cu) ACA (49.8% CuO, 50.2% As_2O_5, AWPA) Cuprinol Tryck (12% CuO, 4.8% caprylic acid) Cu/AAC/NH_3-systems (Cu/AAC=1.0, 0.2, 0.4, 2.0 w/w)	Not applicable	*Pinus radiata* *Fagus sylvatica*	Determination of retention, leaching, soundness, exposure in fungus cellar	P. radiata: optimal protection with CCA; optimal weight ratio of Cu/AAC: 0.2:0.4 98% soundness obtained with: CCA max. 11 months with 0.1% retention of Cu (w/w) ACA max. 11 months with 0.59% retention of Cu (w/w) Cuprinol Tryck max. 1 months with 0.04% retention of Cu (w/w) F. sylvatica: optimal protection with CCA; optimal weight ratio of Cu/AAC: 1.0 100% soundness obtained with: CCA max. 14 months with 0.56% retention of Cu (w/w) ACA max. 14 months with 0.98% retention of Cu (w/w) Cuprinol Tryck max. 4 months with 0.43% retention of Cu (w/w) Retention of Cu: CCA<ACA, ammoniacal systems, Cuprinol Tryck (fixation mechanisms) Leaching of Cu was identical from CCA, ACA, Cu/AAC/NH_3 and Cu/NH_3 in the tested pH-interval (5-7).	**A5/01:** Sundman C.E. (1984) Tests with ammoniacal copper and alkyl-ammonium compounds as wood preservatives. IRG/WP 84-3299

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Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
CCA: chromated copper type C CCB: chromated copper boron CC: chromated copper sulphate Copper sulphate	Not applicable	Cu-adsorption by five wood species *Pinus sylvestris, Homalium foetidum, Alstonia scholaris, Fagus sylvatica, Betula pendula*	Wood samples were mixed with the appropriate solutions at 2% (w/v) CCA equivalent, then leached with distilled water, dried and analysed for the copper content (atomic absorption spectrometry)	Cu-adsorption: Timber species (1h treatment, 6% $CuSO_4$): *H. foetidum* (28%) > *A. scholaris* (23%) > *F. sylvatica* (16%) > *B. pendula* (15%) > *P. sylvestris* (13%) pH: birch, pine: 2.8>2.0, CCA>$CuSO_4$ Concentration: 2%>1% Temperature: birch, pine: unaffected, RT>4°C Source (1 h treatment, 2% w/v): birch CC (23%) > CCB (22%) > CCA (7%) pine: CC (17%) > CCB (16%) > CCA (6%)	**A5/02:** Rennie P.M.S., Gray S.M. & Dickinson D.J. (1987) Copper-based water-borne preservatives: copper adsorption in relation to performance against soft rot. IRG/WP 87-3452
Copper sulphate Ammoniacal copper arsenate Ammoniacal copper/zinc arsenate	Not applicable	Adsorption and diffusion of Cu, Zn, Cr and As on *Pinus resinosa* (red pine), *Populus tremuloides* (trembling aspen)	Following vacuum pressure treatment, the copper content was determined by atomic absorption spectrometry	Adsorption: The copper adsorption is highly pH dependent; the degree of adsorption is positively related to pH of the solution (treatment with 3 mg/g $CuSO_4$: ~20 mg Cu/g red pine and aspen) Diffusion: Adsorption/diffusion equilibrium in solid wood samples is reached much more quickly in red pine than in aspen (both less than 24 h).	**A5/03:** Cooper P.A. (1988) Diffusion and interaction of components of water-borne preservatives in the wood cell wall. IRG/WP 88-3474.

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Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Water soluble copper salts (copper sulphate and copper acetate) and sodium nitrite $NaNO_2$ Copper boron chromium preservative formulation	Not applicable	Comparement of Copper fixation levels obtained with hexavalant chromium containing systems or with solutions containing mixtures of water soluble Copper salts and sodium nitrite	Redwood sapwood, after a fixation period and triplicate leaching, the copper content was analysed by atomic absorption spectrometry	The process of fixation is dependent only on the presence of copper and nitrite ions and not on the nature of the copper salt or other components present. <u>Copper fixation</u>: Copper/Boron: 14.62% (85.38% loss) Copper/Boron/Chromium: 81.59% (18.41% loss) Copper/Boron/Nitrite: 87.01% (12.99% loss) Fixation rate at a Nitrite/Copper molar ratio of 5:1 = 93.1%	**A5/04:** Waldie C. & Cornfield J.A. (1992) Investigation of copper fixation in timber by sodium nitrite. IRG/WP 92-3707.
CBA-A (Copper Azole type A, copper carbonate, boric acid) MEAC (copper carbonate, ethanolamine/water) MEAB (boric acid, ethanolamine/water)	Not applicable	Investigation of the functional groups relevant for copper fixation on wood	Southern yellow pine sawdust was impregnated with test substances, vacuum filtrated, and dried. Copper and/or boron in the treatment solutions and the filtrate were determined by atomic emission spectroscopy.	Adsorbed copper was shown to react exclusively with the carboxyl groups found in hemicellulose constituents, whereas boron was found to react with lignin by the formation of borate esters.	**A5/05:** Thomason S.M & Pasek E.A. (1997) Amine copper reaction with wood components: acidity versus copper adsorption. IRG/WP 97-30161.

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Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
$Cu(OH)_2$ $Cu\ CO_3$ $CuSO_4$ $Cu(NO_3)_2$	Not applicable	Investigation of the interaction of copper amine complexes with wood.	Three treated wood cubes were placed in flasks and submerged in deionised water for 8 days. The retention of copper in the wood and the copper content in the water were analyzed by AAS.	Copper retention and leaching are influenced by the formulation of copper amine complexes. High pH formulation systems result in higher copper retention in wood, but lower copper leaching resistance. The higher the pH of the treating solution is, the more stable the copper amine complex. Thus, the complexes of $Cu(OH)_2$ and $CuCO_3$ are more stable than those of $CuSO_4$ and $Cu(NO_3)_2$. Increase in the molar ratio of amine to copper can improve copper penetration into the wood, and therefore increase the copper retention.	**A5/06:** Zhang J. & Kamdem D.P. (1999) Interaction of copper amine complexes with wood: influence of copper source, amine ligands and amine to copper molar ratio on copper retention and leaching. IRG/WP 99-30203
NaOH-rosin $CuSO_4$	Termites: *Reticulitermes santonensis*	Copper soaps: attachment of copper to the network formed by the inorganic part of the preservative (rosin) through -COOH groups. *Pinus sylvestris* impregnated with NaOH-rosin and $CuSO_4$, leached, determination of the retention according to the EN 84.	Termite laboratory test with 2%, 4%, 6% (w/v) Cu-rosin according to EN117.	Release of Cu^{2+} by hydrolysis of the $-(COO-)_2\ Cu^{2+}$ when very humid conditions occur, this being reversible when wood moisture content is decreasing. Leaching: Cu-rosin used at 4% presents the best behaviour in terms of resistance to leaching. $CuSO_4$ alone leaches out from treated timber. Termite laboratory test: Cu-rosin used at 6% performs well even after leaching. $CuSO_4$ alone leaches out from treated timber.	**A5/07:** Roussel C., Haluk J.P., Pizzi A. & Thevenon M.F. (2000) Copper based wood preservatives: anew approach using fixation with resin acids of rosin. IRG/WP 00-30249.

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Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Copper monoethanolamine treatment solutions were made by dissolving copper hydroxide in aqueous monoethanolamine with a molar ratio amine:copper of 4:1.	Not applicable	Determination of copper absorption by cellulose, hemicellulose and lignin	Combination of wood components: extracted southern pine sapwood (obtained by extracting of milled wood with ethanol/toluene following the Tappi standard method), isolated lignin, holocellulose and cellulose 0.5% (w/v) copper amine solution	Absorption % copper (1 h): Holocellulose 0.33% (wt) Lignin 0.76% (wt) Cellulose 0.06% (wt) The carboxylic groups in hemicellulose and the phenolic hydroxyl in lignin are the major reactive sites for copper.	**A5/08:** Kamdem D.P. & Zhang J. (2000) Contribution of wood components on the absorption of copper amine. IRG/WP 00-30216
Copper 2-ethanolamine Copper ethylenediamine	Not applicable	Depletion of copper from test materials	Scots pine wood blocks, vacuum treated with test substances, were leached with distilled water and citrate buffer solution. The copper content in the leachates and in the leached blocks was determined analytically.	Copper 2-ethanolamine: leaching resistance to distilled water: > 85 % of the initial copper retention. Copper ethylenediamine: leaching resistance to distilled water: 42 % of the initial copper retention. Copper remaining after leaching with the buffered solution: 13 to 51 % of the initial copper retention. The low molar ratios of amine to copper in the leached treated wood suggests that most of the copper is present as copper-wood complexes without amine.	**A5/09:** Jiang W. & Ruddick J.N.R. (2000) A comparison of the leaching resistance of copper 2 - ethanolamine and copper ethylenediamine treated Scots pine. IRG/WP 00-30233.

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Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
ACQ-D formulation (66.6% CuO, 33.3% alkyl dibenzo ammonium chloride with mono-ethanolamine)	Not applicable	Investigation of the effect of the different variables: species, retention and conditioning temperature on copper stabilization and leaching for ACQ-D	Determination of the absorption of copper (Cu-oxide content) from preservative (by X-ray Fluorescence <u>Wood species</u>: *Picea glauca, Abies balsamea, Pinus resinosa, Pinus banksiana, Pseudotsuga menziesii, Populus tremuloides* <u>Concentrations</u>: 0.43%, 0.88%, 1.30%, 1.84%, 2.3% <u>Temperature</u>: 22°C for 4–8 weeks or 54°C for 1 week	The time to stabilisation or equalisation of the copper component of ACQ-D was highly dependent on the concentration of the treatment solution (preservative retention) and post treatment temperature. Stabilisation was rapid for low preservative concentration solutions but extended times were needed for wood treated with higher concentrated solutions. The extent of stabilisation was also concentration-dependent with a higher percentage of copper fixed at lower concentrated treatment solutions. Effect of wood species: Douglas-fir (*Pseudotsuga menziesii*) stabilised at a greater rate and to a higher degree than the other species with heartwood reacting faster and more complete than sapwood. This is likely attributed to the high reactivity of copper with phenolic extractives in Douglas-fir at high pH.	**A5/10:** Ung Y.T. & Cooper P.A. (2004) Effect of species, retention, and conditioning temperature on copper stabilization and leaching for ACQ-D. IRG/WP 04-30342.

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Table A5- 1: Summary table of data on the effectiveness of copper with respect to the fixation of copper in wood in the absence of chromium.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Ammoniacal Copper Quaternary ammonium compounds (ACQ) (66.6 % copper oxide, 33.3 % Didecyl Dimethyl Ammonium Chloride with monoethanolamine as solution concentrations: 0.75%, 1.5 %, 2.25% and 3.0% (CuO = DDAC). Copper monoethanolamine with equivalent amounts of active ingredients (CuO) as in the ACQ solutions.	Not applicable	Fixation mechanism of ACQ subcomponents	Red Pine samples (full-cell impregnated with the two test substances) were conditioned without drying either at 22° C for seven weeks or at 50° C for one week. At different times expressate from the specimen blocks was analyzed for copper, DDAC and MEA.	Copper and MEA adsorption by the wood cell walls followed similar trends. The equilibrium copper adsorption ranged from 44% at high ACQ retentions to about 95% for the lowest retention while the values in the Copper-MEA system were slightly higher for the higher retentions, ranging from about 54% to 93%. This suggests that DDAC may compete with CuMEA for reaction sites at high ACQ concentrations. Adsorption of DDAC into the wood cell matrix was rapid; at all solution concentrations, more than 80% of DDAC was adsorbed by red pine sapwood within minutes after treatment.	**A5/11:** Tascioglu C., Cooper P.A. & Ung Y.T. (2005) Adsorption of ACQ and Cu MEA wood preservatives in red pine IRG/WP 05-30374.

Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Components of chromated copper arsenate (CCA) in equivalent concentrations to the amount in CCA Cu (copper sulphate) CuCr Cr CrAs As CuAs	Brown rot: *Coniophora puteana* Soft rot: *Chaetomium globosum*	Birch blocks Vacuum pressure impregnation Decay was assessed by weight loss.	The blocks were leached according to EN 84.	Fixed copper prevents soft rot attack (<3% CCA equivalent; weight loss <5%) Fixed arsenic prevents attack of copper tolerant brown rot organism (weight loss <5%)	**A5/12:** Gray S. & Dickinson D.J (1987) Copper based water-borne preservatives: the biological performance of wood treated with various formulations. IRG/WP 87-3451.
Chromated copper arsenate (CCA) type C Ammoniacal copper arsenate (ACA) Ammoniacal copper quaternary ammonium compound (ACQ)	Brown rot: *Coniophora puteana* *Poria placenta*	Pinewood stakes pressure-treated Evaluation of decay after 18 months.	Soil-bed system inoculated with *Coniophora puteana* and *Poria placenta*	The toxic limit for this formulation exposed to both fungi was below the lowest concentration of 7.0 kg/m^3, whereas these toxic limits were for CCA between 4.5 and 6.5 kg/ m^3 on *C. puteana* and between 6.5 and 7.5 kg/ m^3 on *P. placenta*.	**A5/13:** Morris P.I. (1990) IUFRO rating system compares favourably to weight loss for soil-bed testing. IRG/WP 90-2343.

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Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Alkylammonium compounds Ammoniacal copper quats (ACQ) and CCA	Not applicable	Treated wood samples were tested in accelerated weathering experiments (Atlas Ci-65 xenon-arc weatherometer, light cycle, rel humidity 50%, frequent wettening, examination: 1600 hours)	Microscopic examination of the surface of the wood samples (Southern yellow pine, *Pinus spp.*) after exposure in a weatherometer	ACQ and CCA treated samples are far less prone to surface weathering (surface defibration, earlywood erosion) than AAC treatments as well as the untreated controls.	**A5/14:** Jin L., Archer K. & Preston A. (1991) Surface characteristics of wood treated with various AAC, ACQ, and CCA formulations after weathering. IRG/WP 91-2369.
Lignin-Copper formulation	White rot fungus *Coriolus versicolor* Brown rot fungus *Fomitpsis pinicola* Termites *Reticulitermes flavipes*	Impregnation of wood with lignin sulphate and copper hydroxide: Field test, mould growth-test, exposure to termites	Impregnated wood in field test: wood exposed for 4 months, for 4 weeks in laboratory (lignin 3–7%, copper 0.35–0.38%) or for 6 months to termites (lignin 4–7%, copper 0.35%)	<u>Field test</u>: excellent efficacy (no decay) after 2 years, with copper 2 kg/m^3 and 8.1 kg/m^3 lignin (lowest tested concentrations; control: 73% decay after 2 years). <u>Mould growth test</u>: until 3 weeks no mould was visible with copper 0.38% and lignin 7% (control: <1 week) <u>Termites</u>: treated samples were intact for 6 months (controls vanished)	**A5/15:** Ohlson B. & Simonson R. (1992) Lignin-copper, a new wood preservative without arsenic and chromium. IRG/WP 92-3702.

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Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Tanalith 3485 (copper, boron, tebuconazole – copper:tebuconazole 25:1) Tanalith 3488 (copper, boron, propiconazole – copper:propiconazole 25:1) Ammoniacal copper quat ACQ (copper, benzalkonium chloride – copper:BAC 2:1) Amine copper quat AmCQ (copper, didecyldimethylammonium chloride – copper:DDAC 2:1) TnBTO (tri-n butyl tin oxide) as reference product	*Coniophora puteana* strain (highly copper tolerant)	Test methodology described in European standard EN 113, modified by using a period of natural weathering instead of the standard artificial weathering procedures EN 73 and EN 84.	The tests were carried out on *Pinus sylvestris* sapwood samples.	Tanalith formulations: toxic threshold values were below 0.50 kg/m^3 before leaching, some loss of activity was recorded after weathering (ca. 0.5–1.5 kg Cu/m^3; loss of boron during this exposure period). AmCQ formulation was more active than the ACQ formulation, with toxic threshold values of 1.5–2.6 kg Cu/m^3, compared to 4.6–5.3 kg Cu/m^3. The AmCQ formulation showed a significant loss of activity after 6 months exposure to natural weathering, with more than 2.6 kg/m^3 copper required for protection against *C. puteana*.	**A5/16:** Williams G.R. & Brown J. (1993) Natural exposure weathering tests: their role in the assessment of wood preservative efficacy. IRG/WP 93-20006.

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Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
CCA type C ACQ type B with 66.7 % CuO and 33.6 % DDAC Copper amine with 71.4 % CuO and 28.6 % AAC (Alkyl Ammonium Compound)	Not applicable	Determination of the protection of wood from decay in soil or above ground. Stakes made of Southern yellow pine sapwood. Test method according to AWPA Standard E 7-92.	(1) Wood in fresh soils (forested area) placed in a greenhouse for 3 years (2) Wood with soil contact in 2 field sites for 5 years (3) “Above ground covered field test”: wood on a layer of perforated concrete blocks laying on the soil in a forest, covered by a black, porous, agricultural shade cloth supported by a wood frame (4 years). (4) the same above ground field test, but without cover (2 years).	Both CCA and ACQ could provide complete protection from decay at the same retention rates.	**A5/17:** Preston A., Archer K. & Jin L. (1994) Performance of copper-based wood preservatives in above ground and ground contact tests. IRG/WP 94-30057.

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Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Copper linoleate (mixture of copper oleic, copper linoleic and copper linolenic salts) or CCA	Protection from decay, fungi and termites	Rating the protection against decay Long term field tests performed at two sites in South Africa, one with prevalence of termite attacks, one with prevalence of fungal decay.	*Pinus patula* impregnated (full-cell process) with: Copper linoleate (1.2 and 1.8 kg/m^3 copper equivalent) CCA (0.71 and 1.42 kg/m^3 copper equivalent)	Copper linoleate is covalently bonded to the wood structure (radical polymerisation mechanism). Both copper linoleate and CCA have performed at comparable levels of efficacy on fungi after 30 years at their respective retentions.	**A5/18:** Conradie D., Turner P., Conradie WE., Pendelebury J. & Pizzi T. (1995) Copper linoleate: a new low toxicity wide spectrum, heavy duty wood preservative. IRG/WP 95-30082
CCA copper-chrome-arsenate DDAC didecyl dimethyl ammonium chloride (+$CuCl_2$, +NH_3) Methyl alkyl benzyl methyl ammonium chloride (BAC) (+$CuCl_2$, +NH_3)	Protection from decay, fungi and termites	Field tests in 3 different areas for a period of 13 years (Japanese standard JIS A 9302) to test the performance of the preservatives	*Pinus radiata* sapwood stakes, treated to saturation	CCA was superior at all test sites (100% soundness). There was very little difference in performance between the two AAC. Addition of copper to treating solutions improved performance (except addition of cuprammonium chloride to BAC to formulate an ammoniacal copper quaternary, which resulted in marked improvement in efficacy.	**A5/19:** Hedley M., Tsunoda K. & Suzuki K. (1995) Field tests of preservative treated radiata pine in Japan. IRG/WP 95-30083.

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Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Ammoniacal copper carbonate Ammoniacal copper sulphate In combination with tribromophenol, propiconazole, naphtenic acid and DDAC (ACQ)	*Postia placenta* (copper tolerant fungus)	Yellow pine sapwood stakes (full cell process) Standard field stake test (AWPA E 10-91)	Area with high activity of copper tolerant fungi Observations annually (3 years) Copper retentions: 0.48 kg/m³ up to 2.4 kg/m³ with a ratio of 2:1 for copper	DDAC formulations with copper carbonate: no decay DDAC and retentions above 2.0 kg/m³ were effective after 3 years.	**A5/20:** Nicholas D.D. & Schultz T.P. (1997) Comparative performance of several ammoniacal copper preservative systems. IRG/WP 97-30151.
Ammoniacal copper alone or in combination with boron, chromium, arsenic, and pentachlorophenol	Not appropriate (determination of decay)	Sapwood stakes of *Pinus sylvestris* were treated using a full cell process.	Field test	Ammoniacal copper alone at retention of 1.9 kg/m³ gave an average service life of 23 years in area 1(soft rot) and 14 years in area 2 (soft rot and brown rot). When the copper retention was doubled to 3.8 kg/m³ the service lives were prolonged by 2–3 years in area 1 and by 8–9 years in area 2. The stake test indicates that ammoniacal copper is effective at the site where soft rot dominates. When brown rot is the prevailing decay type, high concentration of copper or addition of some other more efficient agent is needed.	**A5/21:** Häger B. & Bergman Ö. (1997) Stake test with ammoniacal copper in combination with different agents started in 1962. IRG/WP 97-30130.

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Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
ACQ DDAC Propiconazole TnBTO (12 months only, tested on Scots pine, as standard treatment)	Not appropriate (determination of decay)	Southern yellow pine (Lap-joints)	Field test (exterior timber above ground, frequently 20% moisture content)	Visual assessments according to ENV 12037 indicated that only the untreated joints were starting to fail at 24 months. Colonisation with bacteria and moulds was common throughout 24 months, moulds were inhibited in TnBTO treated samples. Bacteria and yeasts were abundant in propiconazole and DDAC treated samples. Soft-rots were uncommon, with the exception of *Phialophora* sp. (copper tolerant soft-rot) which occurred frequently with ACQ, and rarely in propiconazole treaments. *A. pullants* was dominant on TnBTO treated Lap-joints. A limited number of Basidiomycetes were isolated, especially from the untreated samples (*Phellinus* sp., *Postia placenta*, and *Gloeophyllum* sp.)	**A5/22:** Molnar S, Dickinson DJ, and Murphy RJ (1997): Microbial ecology of treated Lap-joints exposed at Hilo, Hawaii, for 24 months. IRG 97-20107.
Copper azole (Tanalith E) a formulation with elemental copper from copper carbonate, boric acid and tebuconazole in the ratio of 25:10:1. CCA type C	Fungi, termites, brown rot (decay)	Rubberwood test stakes (*Hevea brasiliensis*) were vacuum pressure treated with the two formulations Field test (4 years) in different areas	Rubberwood stakes were treated at 4 retentions with each preservative: CCA from 2.20 kg/m^3 to 6.34 kg/m^3 active element equivalent and Tanalith E from 2.23 to 7.16 kg/m^3.	In New Zealand (fungal hazard, brown rot), the copper azole treatments provide more effective protection to rubberwood than the CCA treatments (80% resp. 60% decay). In Australia (fungal and termite hazards) copper azole treatments were also more effective than CCA, but where termite hazard was predominant, termite attack was mainly located in the parts of the stakes already decayed by fungi. In Malaysia, it was difficult to evaluate the fungal decay, as termite hazard was predominant. Neither preservative is likely to adequately protect rubberwood in critical in-ground situations.	**A5/23:** Drysdale J.A., Hedley, M.E., Loh E. & Hong L.T. (2000) Comparative performance of copper azole and copper chrome arsenate treated rubber wood in Australian, Malaysian and New Zealand test sites. IRG/WP 00-30213.

Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Copper based chromium and arsenic free preservatives CCA	Not applicable	EN 599, comparative experiments complying with the penetration requirements of CCA in comparison with copper containing preservatives.	Determination of the penetration of wood stakes (*Pinus sylvestris*) with the preservatives	Preservatives based on copper as the only metal have a poorer penetration than CCA; Ammoniumhydroxide and rubeanic acid as reagent for copper was the most sensitive to copper and performed better than other reagents tested.	**A5/24:** Jermer J., Evans F.G. & Johanson I. (2001) Experiences with penetration of copper-based wood preservatives. IRG/WP 01-20233.

(continued on next page)

Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
CCA Copper plus triazole preservative Chlorothalonil plus chlorpyriphos Ammoniacal copper plus a quaternary ammonium compound	Not applicable (decay)	*Pinus radiata* *Fagus sylvatica* (treated or untreated) in the ground at 13 sites in New Zealand and Australia (6 years exposure)	<u>Treatment</u>: *Pinus radiata* 4.1 kg/m^3 CCA copper plus triazole preservative (3 kg/m3 of copper); chlorothalonil plus chlorpyriphos in oil (4.8 kg/m³ chlorothalonil Ammoniacal copper plus a quaternary ammonium compound (2.6 kg/m³ copper) 60/40 mixture of high temperature creosote plus oil (61 kg/m³ creosote). *Fagus sylvatica*: 6.1 kg/m^3 CCA copper plus triazole preservative (3 kg/m³ of copper); chlorothalonil plus chlorpyriphos in oil (4.8 kg/m³ chlorothalonil	Preservative performance was significantly affected by site and there was a site-preservative interaction effect where decay hazard at a given site was dependent on preservative treatment. For *Pinus radiata*, copper-azole and ACQ gave at least equivalent performance to the reference standards creosote and CCA after approximately 6 years at the majority of test sites. For *Fagus sylvatica*, copper-azole gave superior protection compared to CCA at the majority of test sites.	**A5/25:** Wakeling R. (2001) Effect of test site location on in-ground preservative performance after six years. IRG/WP 01-20231.

(continued on next page)

Table A5- 2: Summary table of data on the effectiveness of copper to control fungal decay of wood in service (PT 8).

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Review abort arsenic-free alternatives to CCA	Not applicable (review article)	Not applicable	Review article presenting the perspectives from the UK on arsenic-free alternatives to CCA using examples from selected results from across the world, estimating the service life performance that the end user might expect.	Field performance depends on the dominant hazard at the field site. After 6 years in the field, radiata pine treated with copper azole at 3.0 kg/m^3 was performing equivalently or better than CCA at 4.1 kg/m^3. The ACQ at 2.6 kg/m^3 was performing better than CCA at 4.8 Kg/m^3. Comparable performance can be achieved with the alternatives but often higher retentions are required. The retention of copper required to achieve comparable efficacy is highest for ACQ > copper azole > CCA. Copper leaching may be higher with some alternatives (e.g. ACQ) than with the CCA-related fixation process.	**A5/26:** Suttie E.D., Bravery A.F. & Dearling T.B. (2002) Alternatives to CCA for ground contact protection of timber: a perspective from the U.K. performance and service life expectations. IRG/WP 02-30289.

Table A5- 3: Summary table of experimental data on the effectiveness of copper as an active ingredient to control termites in wood in service.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Formulation of Lignin-Copper (wood preservative without arsenic and chromium)	Termites *Reticulitermes flavipes*	Fixation of Lignin-Copper in wood: wood samples were submitted to a two-step vacuum pressure impregnation with a modified lignin sulphate to a water soluble form and in a second step with copper hydroxide.	The samples treated with lignin (4.5 % w/w) and copper (0.35 % w/w) were exposed to termites over a period of 6 months.	All treated samples were intact while the control blocks were completely vanished.	**A5/15:** Ohlson B. & Simonson R. (1992) Lignin-copper, anew wood preservative without arsenic and chromium. IRG/WP 92-3702.
CCA and ACQ	Fungal decay, termites*:* *Coptotermes formosanus.*	Comparison of the relative performance of a range of copper-based wood preservatives	"Above ground covered field test" and "above ground uncovered field test"	In all the tests both CCA and ACQ were tested at the same retention rates. Both products could provide complete protection from termites at the same retention rates.	**A5/17:** Preston A., Archer K.& Jin L. (1994) Performance of copper-based wood preservatives in above ground and ground contact tests. IRG/WP 94-30057.

(continued on next page)

Table A5- 3: Summary table of experimental data on the effectiveness of copper as an active ingredient to control termites in wood in service.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
ACQ formulation CCA	In one of the sites, (Fukiaje Hama) the treated stakes were installed around termite nests of *Reticulitermes* and each individual stake was surrounded by five "bait stakes" of untreated *Pinus thunbergii* stakes.	The grading of termites decay was done independently of the fungal decay, from grade 100 (sound) to 90 (slight evidence of feeding to 3% of x-section), 70 (attack from 10 to 30 % of x-section), 40 (attack from 50 to 75 % of x-section) and 0 (failure).	Field tests performed in Japan, two out of the three sites had high termite hazard.	The ACQ formulation gave equivalent performance to CCA in the 2 termite infested sites with no grading below 90 over the period of 13 years and it appears that ACQ is a viable alternative as wood preservative for termite hazard situations in Japan.	**A5/19:** Hedley M., Tsunoda K. & Suzuki K. (1995) Field tests of preservative treated radiata pine in Japan. IRG/WP 95-30083
Copper linoleate	Ten different termite species were identified, *Macrotermes, Odontotermes, Microtermes, Allondotermes* and *Amitermes*	Long term field tests in two sites in South Africa, one with prevalence of termites attacks	Stakes made of *Pinus patula* sapwood were treated with copper linoleate at retentions of 1.2 and 1.8 kg/m^3 copper metal equivalent and compared to CCA treated stakes at 0.71 and 1.42 kg/m^3 copper metal equivalent. Yearly inspections, observation and sampling.	After 30 years, both products have failed (destroyed stakes, grading of 65.7% for copper linoleate and 78.2 % for CCA) at the lowest retentions. At high retentions, the results for both products were considered acceptable with a grading of 45.7% for copper linoleate and 41.4% for CCA.	**A5/18:** Conradie D., Turner P., Conradie WE., Pendelebury J. & Pizzi T. (1995) Copper linoleate: a new low toxicity wide spectrum, heavy duty wood preservative. IRG/WP 95-30082

(continued on next page)

Table A5- 3: Summary table of experimental data on the effectiveness of copper as an active ingredient to control termites in wood in service.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Copper azole wood preservative Tanalith E (copper as the inorganic compound copper phosphate, boric acid an tebuconazole); in comparison to CCA formulation Tanalith C	Termites: *Coptotermes acinaciformis* and *Mastotermes darwiniensis*	In-ground evaluation at a tropical Australian site: full cell (Bethell) conventional method *Pinus radiata* sapwood specimens	Assessed for degradation by termites after 4, 7, 16 and 27 months	At retentions of 1.02, 1.21 and 1.70 kg/m^3 copper, the copper azole Tanalith E formulation prevents wood from significant attack, i.e. < 5% mass loss. Four retentions of Tanalith E were achieved, i.e. 1.54, 2.08, 2.92 and 4.30 kg/m^3 expressed as copper content. Retention rates of Tanalith C were 0.56 and 1.18 kg/m^3. After 27 months exposure, the mean termite and decay scores for replicate test specimens indicate that performance of Tanalith E is comparable to CCA.	**A5/27:** Creffield J., Drysdale J.A. & Chew N. (1996) In-ground evaluation of a copper azole wood preservative (Tanalith E) at a tropical Australian test site. IRG/WP 96-30100.

Table A5- 4: Efficacy of copper as an active ingredient to control marine borers in wood in service.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Two copper amine complexes (Cu-pentachloro-phenoxide ammoniacal and Cu-Caprylicacid Ammoniacal formulation) in comparison with copper-chrome formulations	Molluscan borers Terinidae, *Teredo navalis* and *Teredo megotara* and crustacean borer, *Limnoria lignorum*	NWPC Standard N° 1.4.2.2/73 Cu-pentachloro-phenoxide ammoniacal with five retentions in kg/m^3 expressed in copper a.i.: 2.49, 3.70, 5.00, 6.13, and 7.45 Cu-Caprylicacid Ammoniacal with retentions 2.25, 3.39, 4.61, 5.82 and 6.82 kg/m^3	Sapwood blocks of Scots pine *Pinus sylvestris*, European beech *Fagus sylvatica* and European birch *Betula verrucosa* were impregnated	Retentions of less than 6 kg/m^3 failed after 5 years for the copper amine complexes, whereas retentions of 3 to 4 kg/m^3 of copper were sufficient in copper chrome formulations for a protection until the end of the testing period of 6.5 years.	**A5/28:** Henningson B. & Norman E . (1980) A marine borer test with waterborne preservatives. IRG/WP 80-452.

Table A5- 5: Fungal tolerance towards Copper.

Test substance	Test organism(s)	Test method	Test conditions	Test results: effects, mode of action, resistance	Reference
Copper (II) octanoate with ethanolamine Copper (II) sulphate ($cCu = 1.0 \times 10^{-2}$ mol/l)	Brown rot fungi, *Antrodia vaillantii*	Mechanisms of copper tolerance	Impregnated and non-impregnated test pieces of spruce wood (*Picea abies*) samples were exposed to wood rotting fungus for 12 weeks	After four weeks of exposure to *A. vaillantii*, Cu^{2+} was translocated or converted into a form undetectable by Electron Paramagnetic Resonance (EPR). Oxalic acid excreted by this fungus reacts with Cu^{2+} in the wood to give insoluble and thus non-toxic copper oxalate, enabling the fungus to grow and thus to attack the wood (→ decay). Decay did not occur with copper octanoate with ethanolamine (formation of insoluble copper oxalate is impossible).	**A5/29:** Humar M., Petric M., Pohleven F. & Sentjurc M. (2000) Changes of EPR spectra of wood impregnated with copper based preservative during exposure to *Antrodia vaillantii*. IRG/WP 00-10355.
Copper-amine fluorine based preservative Copper sulphate Chromated copper borate Copper naphtenate	Copper-tolerant *Antrodia. vaillantii* isolates Copper intolerant fungus *Gloeophyllum trabeum*	Screening test and the standard laboratory test EN 113	Preservative solutions: Final concentrations: 5×10^{-4}, 1×10^{-3}, 5×10^{-3}, 1×10^{-2}, 2.5×10^{-2} mol/l of copper. Solidified medium was inoculated with pieces of mycelium of wood rotting fungi. Fungal growth was estimated visually and compared with growth of controls.	The presence of amine in copper amine treated wood prevented the formation of copper oxalate, thus copper remained soluble and decay by the copper tolerant strains did not take place. Copper sulphate, copper naphtenate: decay, no protection. CCB and copper amine treated wood: no decay (which is explained by the presence of boron in CCB)	**A5/30:** Pohleven F., Humar M., Amartey S. & Benedik J. (2002) Tolerance of wood decay fungi to commercial copper-based wood preservatives. IRG/WP 02-30291.

Section A6.1.1 Acute Oral Toxicity

Annex Point IIA6.1

			Official use only
		1 REFERENCE	
1.1	**Reference**	[redacted] (1988): Acute oral toxicity in rats with COPPER HYDROXIDE (in accordance with OECD Principle 401). Study performed by [redacted], project no.: 1-4-1600-88. Unpublished report. Doc. no. URA-97-08740-045	
1.2	**Data protection**	Yes	
1.2.1	Data owner	Spiess-Urania Chemicals GmbH	
1.2.2	Companies with letter of access		
1.2.3	Criteria for data protection	Data submitted to the MS after 13 May 2000 on existing active substance for the purpose of its entry into Annex I	
		2 GUIDELINES AND QUALITY ASSURANCE	
2.1	**Guideline study**	Yes OECD Principle 401	
2.2	**GLP**	No. GLP was not compulsory for studies conducted in 1988	
2.3	**Deviations**	No	
		3 MATERIALS AND METHODS	
3.1	**Test material**	As given in section A2	
3.1.1	Lot/Batch number	unknown	
3.1.2	Specification	As given in section A2	
3.1.2.1	Description	The test preparation is a fine turquoise powder	
3.1.2.2	Purity	As given in section A2	
3.1.2.3	Stability	Copper hydroxide is stable at 54°C over 2 weeks The test substance was stored at ambient temperature in a dark place..	
3.2	**Test Animals**		
3.2.1	Species	rat	
3.2.2	Strain	Crl.: (WI) BR - Wistar	
3.2.3	Source	[redacted]	
3.2.4	Sex	male and female	
3.2.5	Age/weight at study initiation	male: 247 - 289 g female: 188 - 228 g	
3.2.6	Number of animals per group	5 female and 5 male Wistar per group	
3.2.7	Control animals	No	

Section A6.1.1 Acute Oral Toxicity

Annex Point IIA6.1

3.3	**Administration/ Exposure**	Oral
3.3.1	Postexposure period	14 days
		Oral
3.3.2	Type	The test substance was applied once using a rigid oesophageal tube
3.3.3	Concentration	250 mg/kg 500 mg/kg 1000 mg/kg 1500 mg/kg
3.3.4	Vehicle	aqueous solution (deionized water)
3.3.5	Concentration in vehicle	20 % solution
3.3.6	Total volume applied	250 - 1500 mg/kg
3.3.7	Controls	no
3.4	**Examinations**	Clinical observations and dissection
3.5	**Method of determination of LD_{50}**	Probit Analysis according to Finney
3.6	**Further remarks**	

4 RESULTS AND DISCUSSION

(see Table A6.11..1-1 Mortalities and LD_{50}-values)

4.1	**Clinical signs**	In the dosage tested the preparation increasingly incurred distinct disturbances of consciousness with corresponding apathy, slight tremors and spasms or cramps, distinctly impaired coordination, slightly mucosa, reduced respiratory rate and body temperature. The symptoms indicated were determined at first after approx. 20 min. p.a. and persisted in the surviving animals first with increasing intensity then with decreasing intensity in some cases up to 3 days p.a. Thereafter these animals resumed a normal habitus. In the case of mortality the symptoms were determined with constant intensity until death
4.2	**Pathology**	With the mortalities, distinct substance residues were discovered in some cases in the gastro-intestinal tract and in some cases, slight reddening of haemorrhage of the digestive tract mucosa. During the final post-mortem examination (14 days p.a.) on all surviving animals there were no signs of macroscopically visible organ changes in the cranial cavity, thoracic cavity and abdominal cavity
4.3	**Other**	The mean body weight of the surviving animals indicated a normal increase in weight in comparison with the initial value.

4.4	**LD_{50}**	**LD_{50} [mg/kg]**	**after 24 h**	**after 48 h**	**after 14 days**

Section A6.1.1 Acute Oral Toxicity

Annex Point IIA6.1

LD_{50} (male)	989	878	878
LD_{50} (female)	863	863	657
LD_{50} (male + female)	924	819	763

5 APPLICANT'S SUMMARY AND CONCLUSION

5.1 Materials and methods

5 male and 5 female Wistar rats per group were used for the investigation of the acute toxic effect of Copper hydroxide after a single oral application.
Within a 14-day follow-up period the median lethal dose was to be determined.

The test was conducted in accordance with the OECD Principle 401 of Good Laboratory Practice in Testing of Chemicals (Paris 1982)

5.2 Results and discussion

The preparation incurred disturbance of consciousness (apathy), impaired coordination, spasm/tremor and cramp, cyanosis/pallor, reduced reflex excitability, piloerection, reduced respiratory rate and a decrease in body temperature.

The mortalities indicated substance accumulation in the gastro-intestinal tract and redness or haemorrhage of the gastro-intestinal nucosa. The results of the final post-mortem examination (14 day p.a.) were normal.

5.3 Conclusion

5.3.1 Reliability

The acute oral LD_{50} (calculated by probit analysis) of copper hydroxide to the rat was 878 mg/kg bw for males (with 95 % confidence limits of 582 to 3025 mg/kg bw), 657 mg/kg bw for females and 763 mg /kg bw for the sexes combined (with 95 % confidence limits of 527 to 1272 mg/kg bw).
Therefore relating to classification, packaging and labelling of dangerous substances and preparations, copper hydroxide is classified as 'Harmful' (Xn) and requires the Risk Phrase R22 'Harmful if swallowed'. X

Reliability indicator: 2

5.3.2 Deficiencies

No

Section A6.1.1 Acute Oral Toxicity

Annex Point IIA6.1

	Evaluation by Competent Authorities
	Use separate "evaluation boxes" to provide transparency as to the comments and views submitted
	EVALUATION BY RAPPORTEUR MEMBER STATE
Date	07/01/05
Materials and Methods	Agree with applicant's version
Results and discussion	Agree with applicant's version
Conclusion	Agree with applicant's version § 5.3.1 should be place in the 5.3 box and reliability is 2
Reliability	2
Acceptability	Acceptable
Remarks	
	COMMENTS FROM ...
Date	*Give date of comments submitted*
Materials and Methods	*Discuss additional relevant discrepancies referring to the (sub)heading numbers and to applicant's summary and conclusion.* *Discuss if deviating from view of rapporteur member state*
Results and discussion	*Discuss if deviating from view of rapporteur member state*
Conclusion	*Discuss if deviating from view of rapporteur member state*
Reliability	*Discuss if deviating from view of rapporteur member state*
Acceptability	*Discuss if deviating from view of rapporteur member state*
Remarks	

Table A6.1.1-1 Acute Oral Toxicity: Mortalities and LD_{50} values

Dose [mg/kg bw]	Number of dead						Observations m = male f = female
	24 h		48 h		3/14 days		
	m	f	m	f	m	f	
250	0/5	0/5	0/5	1/5	0/5	1/5	
500	1/5	2/5	1/5	2/5	1/5	2/5	
1000	2/5	1/5	3/5	1/5	3/5	2/5	
1500	4/5	5/5	4/5	5/5	4/5	5/5	
LD_{50} value	989	863	878	863	878	657	
LD_{50} (m & f)	924		819		763		

Section A6.1.2 Acute Dermal Toxicity

Annex Point IIA6.1

			Official use only
		1 REFERENCE	
1.1	**Reference**	[redacted]. (1988): Acute dermal toxicity in rats with copper hydroxide (in accordance with OECD Principle 402) - Limit test. - Study performed by [redacted] project no.: 1-4-1601-88. Unpublished report.	
		Doc. no. URA-97-08740-046	
1.2	**Data protection**	Yes	
1.2.1	Data owner	Spiess-Urania Chemicals GmbH, Hamburg, Germany	
1.2.2	Companies with letter of access		
1.2.3	Criteria for data protection	Data submitted to the MS after 13 May 2000 on existing active substance for the purpose of its entry into Annex I	
		2 GUIDELINES AND QUALITY ASSURANCE	
2.1	**Guideline study**	Yes	
		EC 84/449/EEC; OECD Principle 402 (1987)	
2.2	**GLP**	No GLP is not compulsory for studies conducted in 1988	
2.3	**Deviations**	No	
		3 MATERIALS AND METHODS	
3.1	**Test material**	As given in section A2	
3.1.1	Lot/Batch number	not stated	
3.1.2	Specification	As given in section A2	
3.1.2.1	Description	The test preparation is a fine turquoise powder	
3.1.2.2	Purity	As given in section A2	
3.1.2.3	Stability	As given in section A2	
		The test substance was stored at ambient temperature in a dark place.	
3.2	**Test Animals**		
3.2.1	Species	rat	
3.2.2	Strain	Crl.: (WI) BR - Wistar	
3.2.3	Source	[redacted]	
3.2.4	Sex	male and female	
3.2.5	Age/weight at study initiation	male: 173.2 - 202.4 g female: 210.7 - 245.3 g	
3.2.6	Number of animals per group	5 female and 5 male Wistar per group	X
3.2.7	Control animals	No	

Section A6.1.2 Acute Dermal Toxicity

Annex Point IIA6.1

3.3	**Administration/ Exposure**	dermal
		Dermal
3.3.1	Area covered	Applied on the shorn skin on the back (8 x 5 cm)
3.3.2	Occlusion	semiocclusive (covered with gauze)
3.3.3	Vehicle	The test substance was applied with a mull pad direct to the shorn skin
3.3.4	Concentration in vehicle	The test substance was applied undiluted. To improve adherence to the shorn skin, the measured test powder/animal was moistened wit h 2-3 drops of Ampuwa
3.3.5	Total volume applied	2000 mg/kg bw
3.3.6	Duration of exposure	24 h
3.3.7	Removal of test substance	not reported
3.3.8	Controls	no controls
3.4	**Examinations**	Clinical observations observations of skin changes, bodand dissection
3.5	**Method of determination of LD_{50}**	not reported
3.6	**Further remarks**	The assessment of clinicotoxicological symptoms was performed in according to Irvin Screening from Screening Methods in Pharmacology, R.A. Turner, 1965. For the observation of the skin changes the modified Draize system was used.

Section A6.1.2 **Acute Dermal Toxicity**

Annex Point IIA6.1

4 RESULTS AND DISCUSSION

4.1 Clinical signs

Mortalities
No mortalities were observed during the entire test period.

Effectiveness
The preparation caused no clinicotoxicological symptoms during the entire observation period.

Skin changes
The preparation caused no macroscopically visible skin changes in the treated areas during the entire observation period of 14 days.

4.2 Pathology

Dissection

During the dissection on completion of the 14 day follow up period, there were no signs of macroscopically visible organ changes in the cranial cavity, thoracic cavity and abdominal cavity.

4.3 Other

Body weight
The mean body weight indiated a normal increase in weight in comparison with the initial value

4.4 LD_{50}

LD_{50} [mg/kg]	after 24 h	after 14 days
LD_{50} (male)	> 2000	> 2000
LD_{50} (female)	> 2000	> 2000
LD_{50} (male + female)	> 2000	> 2000

5 APPLICANT'S SUMMARY AND CONCLUSION

5.1 Materials and methods

5 male and 5 female Wistar rats per group were used for the investigation of the acute dermal toxicity of Copper hydroxide. Over a period of 14 days the clinicotoxicological symptoms and the acute mortalities were recorded.
After the experiment the killed animals were examined for macroscopic organ changes in the cranial cavity, thoracic cavity and abdominal cavity.
The animals were also observed for the skin changes in the areas of application.

5.2 Results and discussion

During the entire observation period ther were no clinicotoxicological symptoms of skin reaction on the areas of application of the test animals.
At the end of th 14-day follow-up time the surviving animals displayed normal weight development in comparison with the initial value.
There were no mortalities observed.
The results of final post-mortem examination were normal.

5.3 Conclusion

5.3.1 Reliability

The acute dermal LD_{50} of copper hydroxide to the rat was greater than 2000 mg/kg bw for males and females. According to the Directives

Section A6.1.2 Acute Dermal Toxicity

Annex Point IIA6.1

	67/548/EEC (as amended, adapting to technical progress, by Directives 93/21/EE; 1999/EC and 2001/59/EC in relation to classification, packaging and labelling of dangerous substances and preparations), copper hydroxide is not classified.
	Reliability indicator: 2
5.3.2 Deficiencies	No

	Evaluation by Competent Authorities
	Use separate "evaluation boxes" to provide transparency as to the comments and views submitted
	EVALUATION BY RAPPORTEUR MEMBER STATE
Date	06/01/05
Materials and Methods	3.2.6 – Only 5 males and 5 females were tested in the main study (limit test) Agree with applicant's version
Results and discussion	Agree with applicant's version
Conclusion	Agree with applicant's version
Reliability	2
Acceptability	Acceptable
Remarks	
	COMMENTS FROM ...
Date	*Give date of comments submitted*
Materials and Methods	*Discuss additional relevant discrepancies referring to the (sub)heading numbers and to applicant's summary and conclusion.* *Discuss if deviating from view of rapporteur member state*
Results and discussion	*Discuss if deviating from view of rapporteur member state*
Conclusion	*Discuss if deviating from view of rapporteur member state*
Reliability	*Discuss if deviating from view of rapporteur member state*
Acceptability	*Discuss if deviating from view of rapporteur member state*
Remarks	

Section A6.1.2 Acute Dermal Toxicity

Annex Point IIA6.1

Table A6.1.1-1 Acute Dermal Toxicity: Mortalities and LD_{50} values

Dose [mg/kg bw]	Number of dead				Observations m = male f = female
	24 h		14 days h		
	m	f	m	f	
2000	0/5	0/5	0/5	0/5	
LD_{50} value	> 2000	> 2000	> 2000	> 2000	
LD_{50} (m & f)	> 2000				

Section A6.1.3 — Acute Inhalation Toxicity

Annex Point IIA6.1 — Rat

Official use only

		6 REFERENCE
6.1	**Reference**	[redacted] (2003): Acute inhalation toxicity study of SPU-00620-F in rats - according to EC guideline B.2. and OECD guideline 403. – Study performed at [redacted] [redacted] Report No. 17150/03 dated 18.12.2003
6.2	**Data protection**	Yes
6.2.1	Data owner	Spiess-Urania Chemicals GmbH
6.2.2	Companies with letter of access	--
6.2.3	Criteria for data protection	Data submitted to the MS after 13 May 2000 on existing active substance for the purpose of its entry into Annex I
		7 GUIDELINES AND QUALITY ASSURANCE
7.1	**Guideline study**	Yes EC guideline L 383 A: B.2., OECD guideline 403 Annex IIB Biozid-Richtlinie
7.2	**GLP**	Yes
7.3	**Deviations**	No
		8 MATERIALS AND METHODS
8.1	**Test material**	SPU-00620-F (copper hydroxide technical active ingredient)
8.1.1	Lot/Batch number	#23063
8.1.2	Specification	As given in section 2
8.1.2.1	Description	blue powder geometric mean diameter: 2.255 µm
8.1.2.2	Purity	active agents: copper: 63.1%
8.1.2.3	Stability	March 11, 2005
8.2	**Test Animals**	
8.2.1	Species	rat
8.2.2	Strain	CD® / Crl: CD®
8.2.3	Source	[redacted]
8.2.4	Sex	males and females

Section A6.1.3		Acute Inhalation Toxicity
Annex Point IIA6.1		Rat
8.2.5	Age/weight at study initiation	Age (at start of adaptation): 45 days (males) 56 days (females) Body weight (at dosing): 203-240 g (males) 199-224 g (females)
8.2.6	Control animals	No
8.3	**Administration/ Exposure**	**Inhalation**
8.3.1	Concentrations	Nominal concentration 0.3 / 1.4 / 5.6 / 33.3 mg/L air Analytical concentration .... 0.045 / 0.205 / 1.08 / 6.00 mg/L air
8.3.2	Particle size	Mass median aerodynamic diameter (MMAD): • 2.828 µm (1.08 mg SPU-00620-F/L air) • 2.606 µm (6.00 mg SPU-00620-F/L air) Geometric standard deviation (GSD): • 4.921 (1.08 mg SPU-00620-F/L air) • 4.974 (6.00 mg SPU-00620-F/L air)
8.3.3	Type or preparation of particles	Dust
8.3.4	Type of exposure	Nose-only exposure
8.3.5	Vehicle	The test item was used as supplied.
8.3.6	Concentration in vehicle	Not applicable
8.3.7	Duration of exposure	4 h
8.3.8	Controls	no control
8.4	**Examinations**	Clinical observations (14 days after completion of exposure) Necropsy
8.5	**Method of determination of LD_{50}**	Probit Analysis according to Finney
8.6	**Further remarks**	Not stated

Section A6.1.3 Annex Point IIA6.1		Acute Inhalation Toxicity Rat
		9 RESULTS AND DISCUSSION
9.1	**Clinical signs**	**Mortality** at 6.00 mg/L: 5 of 5 males, 5 females, at 1.08 mg/L: 5 of 5 males, 3 of 5 females, at 0.205 mg/L: 1 of 5 male **Clinical signs:** 6.00 mg/L: moderately reduced motility, moderate ataxia and dyspnoea 1.08 mg/L: slightly to moderately reduced motility, moderate ataxia, moderately reduced muscle tone and moderate dyspnoea 0.205 mg/L: slightly reduced motility, slight ataxia and slight dyspnoea 0.045 mg/L: no signs of toxicity, no mortality
9.2	**Pathology**	no pathological findings
9.3	**Other**	none
9.4	**LC_{50}**	0.205 < LC_{50} < 1.08 mg/L air for 4 hours at 14 days
		10 APPLICANT'S SUMMARY AND CONCLUSION
10.1	**Materials and methods**	Acute inhalation toxicity study of SPU-00620-F in rats; according to EC guideline B.2. and OECD guideline 403
10.2	**Results and discussion**	A 4-h exposure to SPU-00620-F at a concentration of 6.00 mg/L air revealed moderately reduced motility, moderate ataxia and moderate dyspnoea in 1 male and 1 female. All males and females died prematurely. A 4-h exposure to SPU-00620-F at a concentration of 1.08 mg/L air revealed slightly to moderately reduced motility, slight to moderate ataxia, moderately reduced muscle tone and slight dyspnoea. 5 males and 3 of 5 females died prematurely. A 4-h exposure to SPU-00620-F at a concentration of 0.205 mg/L air revealed slightly reduced motility, slight ataxia and slight dyspnoea. One of 5 males died prematurely. 0.045 mg/L air caused no toxic symptoms. LC_{50} males and females combined: approx. 0.56 mg SPU-00620-F/L air SPU-00620-F has to be classified as toxic.
10.3	**Conclusion**	
10.3.1	Reliability	1
10.3.2	Deficiencies	No

Section A6.1.3 **Acute Inhalation Toxicity**

Annex Point IIA6.1 **Rat**

	Evaluation by Competent Authorities
	Use separate "evaluation boxes" to provide transparency as to the comments and views submitted
	EVALUATION BY RAPPORTEUR MEMBER STATE
Date	06/01/05
Materials and Methods	Agree with applicant's version
Results and discussion	Agree with applicant's version
Conclusion	Agree with applicant's version
Reliability	1
Acceptability	Acceptable
Remarks	
	COMMENTS FROM ...
Date	*Give date of comments submitted*
Materials and Methods	*Discuss additional relevant discrepancies referring to the (sub)heading numbers and to applicant's summary and conclusion.* *Discuss if deviating from view of rapporteur member state*
Results and discussion	*Discuss if deviating from view of rapporteur member state*
Conclusion	*Discuss if deviating from view of rapporteur member state*
Reliability	*Discuss if deviating from view of rapporteur member state*
Acceptability	*Discuss if deviating from view of rapporteur member state*
Remarks	

Table A6.1.3-1 **Table for Acute Toxicity (modify if necessary)**

Dose [mg/L air]	**Number of dead / number of investigated**	**Time of death (range)**	**Observations**
0.045	0/10		none
0.205	1/10	3 h after end of exposure	slightly reduced motility, slight ataxia and slight dyspnoea in 4/5 males and 5/5 females; 1 male died .
1.08	6/10	0' – 3 h after end of exposure	slightly to moderately reduced motility, slight to moderate ataxia, moderately reduced muscle tone and slight to moderate reduced muscle tone and slight to moderate dyspnoea
6.00	10/10	0*	5 males and 5 females died prematurely.
LC_{50} value	$0.205 < LC_{50} < 1.08$ mg/L air for 4 hours at 14 days		

0* immediately after end of expsoure

Section A6.1.4.1 Skin Irritation

Annex Point IIA6.1

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	11 REFERENCE	
11.1	**Reference**	[redacted] (1988): Cutaneous irritation test with copper hydroxide on the rabbit. – Study performed by [redacted], unpublished report no.: 1-3-1315-88 Doc. no. 97-08740-048
11.2	**Data protection**	Yes
11.2.1	Data owner	Spiess-Urania Chemicals GmbH, Hamburg, Germany
11.2.2	Companies with letter of access	
11.2.3	Criteria for data protection	Data submitted to the MS after 13 May 2000 on existing active substance for the purpose of its entry into Annex I
	12 GUIDELINES AND QUALITY ASSURANCE	
12.1	**Guideline study**	Yes Directive 84/449/EEC, B.4 "Acute toxicity (skin irritation)"; in accordance with OECD Principle 404
12.2	**GLP**	No GLP is not compulsory for studies conducted in 1988
12.3	**Deviations**	No
	13 MATERIALS AND METHODS	
13.1	**Test material**	As given in section 2
13.1.1	Lot/Batch number	unknown
13.1.2	Specification	As given in section 2
13.1.2.1	Description	The test preparation is a fine turquoise powder.
13.1.2.2	Purity	As given in section 2
13.1.2.3	Stability	Copper hydroxide is stable at 54°C over 2 weeks The test substance was stored at ambient temperature in a dark place.
13.2	**Test Animals**	
13.2.1	Species	rabbit
13.2.2	Strain	White New Zealand (WNZ)
13.2.3	Source	[redacted]
13.2.4	Sex	not stated

Section A6.1.4.1 Skin Irritation

Annex Point IIA6.1

13.2.5	Age/weight at study initiation	Age: not stated Weight: 2.4 - 2.8 kg
13.2.6	Number of animals per group	6 rabbits were used for the test
13.2.7	Control animals	Not stated
13.3	**Administration/ Exposure**	Dermal
13.3.1	Application	
13.3.1.1	Preparation of test substance	During the experiment the test substance was used unchanged.
13.3.1.2	Test site and Preparation of Test Site	After an acclimatisation period (7 days) the animals were shaved on the back with an electric razor over an aerea of approx. 8x15 cm one day prior to the start of the experiment. On the day of the test the left-hand side of the shaved area was scarified with a sterile needle so that the stratum corneum but not the corium was penetrated. The right-hand side of the shaved area remained intact.
13.3.2	Occlusion	After application the treated areas were immediately covered with "Kosmoplast" plaster and also secured with "Elastoplast" which is permeable to air (semiocclusive) In addition the entire trunk was wrapped with "Stülpa" for 4 hours.
13.3.3	Vehicle	A vehicle was not reported in the study
13.3.4	Concentration in vehicle	--
13.3.5	Total volume applied	0.5 g of the test substance was applied to the right (intact) and to the left (scarified) half of the back each time. The treated area was approx. 2.5 x 2.5 cm in each case.
13.3.6	Removal of test substance	The substance residue was carefully washed of with lukewarm water.
13.3.7	Duration of exposure	4 hours
13.3.8	Postexposure period	72 hours p.a.
13.3.9	Controls	Comparison between scarified and intact skin
13.4	**Examinations**	
13.4.1	Clinical signs	Not observed
13.4.2	Dermal examination	Yes
13.4.2.1	scoring system	A scoring system for the evaluation of erythema and scab formation and oedema formation from 0 (no erythema/oedema) to 4 (severe erythema/oedema) according to OECD Guideline 404 was used.
13.4.2.2	Examination time points	30 - 60 min, 24 h, 48 h and 72 h (according to method of Draize)
13.4.3	Other examinations	not reported

Section A6.1.4.1 Skin Irritation

Annex Point IIA6.1

13.5 Further remarks --

14 RESULTS AND DISCUSSION

14.1 Average score

14.1.1 Erythema

	24 h	48 h	72 h
scarified skin	2	1.33	0.67
intact skin	1.83	1	0.33

14.1.2 Oedema

	24 h	48 h	72 h
scarified skin	0	0	0
intact skin	0	0	0

14.2 Reversibility not stated

14.3 Other examinations Other examinations are not conducted

14.4 Overall result The overall average score (according to Draize) at all observation times was 1.29 for erythema. No oedema was recorded.

Section A6.1.4.1 Skin Irritation

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		15 APPLICANT'S SUMMARY AND CONCLUSION	
15.1	**Materials and methods**	6 WNZ rabbits were used for the cutaneous irritation test of copper hydroxide. The exposure time of the test substance on the shaved skin on the back (scarified and intact) was 4 hours. All reactions such as erythema and oedema were observed for a period of 72 hours p.a. (Draize method) The test was conducted according to the Directive 84/449/EEC, B.4 "Acute toxicity (skin irritation)" and in accordance with OECD guideline 404	
15.2	**Results and discussion**	Slight erythema (score 1 or 2) was noted in all animals after 30 to 60 min and after 48 h. Ager 72 h slight effects (score 1) were still present in four animals (intact skin). Mean scores (24 to 72 h) were 1.3 for scarified skin an 1.1 for intact skin. No oedema was recorded.	
15.3	**Conclusion**	Copper hydroxide was slightly irritating to intact rabbit skin (means scores 24 to 72 h for erythema and oedema on intact skin were 1.1 and 0, respectively, i.e. less than 2). According to the Directives 67/548/EEC (as amended, adapting to technical progress, by Directives 93/21/EEC; 1999/45/EC and 2001/59/EC in relation to classification, packaging and labelling of dangerous substances and preparations), copper hydroxide is not classified as a skin irritant.	
15.3.1	Reliability	Reliability indicator: 2	
15.3.2	Deficiencies	No	

Section A6.1.4.1 Skin Irritation

Annex Point IIA6.1

	Evaluation by Competent Authorities
	Use separate "evaluation boxes" to provide transparency as to the comments and views submitted
	EVALUATION BY RAPPORTEUR MEMBER STATE
Date	06/01/05
Materials and Methods	Agree with applicant's version.
Results and discussion	Agree with applicant's version.
Conclusion	Agree with applicant's version.
Reliability	2
Acceptability	Acceptable
Remarks	
	COMMENTS FROM ...
Date	*Give date of comments submitted*
Materials and Methods	*Discuss additional relevant discrepancies referring to the (sub)heading numbers and to applicant's summary and conclusion.* *Discuss if deviating from view of rapporteur member state*
Results and discussion	*Discuss if deviating from view of rapporteur member state*
Conclusion	*Discuss if deviating from view of rapporteur member state*
Reliability	*Discuss if deviating from view of rapporteur member state*
Acceptability	*Discuss if deviating from view of rapporteur member state*
Remarks	

Section A6.1.4.1 Skin Irritation

Annex Point IIA6.1

Table A6.1-1 Table for skin irritation study

Evaluation object	Erythema											
Animals observed	1		2		3		4		5		6	
Assessed skin: (s: scarified skin, i: intact skin)	s	i	s	i	s	i	s	i	s	i	s	i
30 - 60 min	2	2	2	2	2	2	2	2	2	2	2	2
24 h	2	2	2	2	2	2	2	1	2	2	2	2
48 h	1	1	1	1	2	1	1	1	1	1	1	1
72 h	0	0	1	1	1	0	0	0	1	1	1	0
Mean score (24 - 72 hours)	scarified skin: 1.3											
	intact skin: 1.1											

Evaluation object	Oedema											
Animals observed	1		2		3		4		5		6	
Assessed skin: (s: scarified skin, i: intact skin)	s	i	s	i	s	i	s	i	s	i	s	i
30 - 60 min	0	0	0	0	0	0	0	0	0	0	0	0
24 h	0	0	0	0	0	0	0	0	0	0	0	0
48 h	0	0	0	0	0	0	0	0	0	0	0	0
72 h	0	0	0	0	0	0	0	0	0	0	0	0
Mean score (24 - 72 hours)	scarified skin: 0.0. intact skin: 0.0											

Section 6.1.4.2 Eye Irritation

Annex Point IIA6.1

		Official use only
	16 REFERENCE	
16.1 Reference	[redacted] (1988): Eye irritation test with copper hydroxide on the rabbit. – Study performed by [redacted], unpublished report no.:1-3-1314-88 Doc. no. 97-08740-049	
16.2 Data protection	Yes	
16.2.1 Data owner	Spiess-Urania Chemicals GmbH, Hamburg, Germany	
16.2.2 Companies with letter of access		
16.2.3 Criteria for data protection	Data submitted to the MS after 13 May 2000 on existing active substance for the purpose of its entry into Annex I	
	17 GUIDELINES AND QUALITY ASSURANCE	
17.1 Guideline study	Yes	
	EU guideline 84/449/EEC; OECD Principle 405	
17.2 GLP	No	
	GLP is not compulsory for studies conducted in 1988	
17.3 Deviations	No	
	18 MATERIALS AND METHODS	
18.1 Test material	As given in section 2	
18.1.1 Lot/Batch number	Unknown	
18.1.2 Specification	As given in section 2	
18.1.2.1 Description	The test preparation is a fine turquoise powder	
18.1.2.2 Purity	As given in section 2	
18.1.2.3 Stability	Copper hydroxide is stable at 54°C over 2 weeks	
	The test substance was stored at ambient temperature in a dark place.	

Section 6.1.4.2 Eye Irritation

Annex Point IIA6.1

18.2	**Test Animals**		
18.2.1	Species	Rabbit	
18.2.2	Strain	White New Zealand	
18.2.3	Source	[redacted]	
18.2.4	Sex	not stated	
18.2.5	Age/weight at study initiation	Age: not stated Weight: range at the start of experiment: 2.4 - 2.8 kg	
18.2.6	Number of animals per group	6 animals were taken for the test	
18.2.7	Control animals	No	
18.3	**Administration/ Exposure**		
18.3.1	Preparation of test substance	Test substance was used unchanged	
18.3.2	Amount of active substance instilled	In each case 0.1 g was applied to the left eye. By three animals the treated eye was carefully rinsed with 10 mL lukewarm water 4 sec. p.a.	X
18.3.3	Exposure period	72 h	
18.3.4	Postexposure period	72 h p.a.	
18.4	**Examinations**		
18.4.1	Ophthalmoscopic examination	No	
18.4.1.1	Scoring system	Individual irritation scores according to Draize. The elements of evaluation system were: • Cornea: degree of opacity Score range: 0 (no ulceration) - 4 (opal cornea) • Iris: Score range: 0 (normal) - 2 (no reaction to light) • Conjunctiva: reddening and chemosis on lids and/or nictitating memranes A: Reddening: Score range: 0 (blood vessels normal) - 3 (diffused bright red) B: Chemosis Score range: 0 (no swelling) - 4 (swelling with lids more than half closed)	
18.4.1.2	Examination time points	1 h , 24 h, 48 h, 72 h after treatment	
18.4.2	Other investigations	effect of rinsing (conducted in 50 % of the treatments)	
18.5	**Further remarks**	not reported	