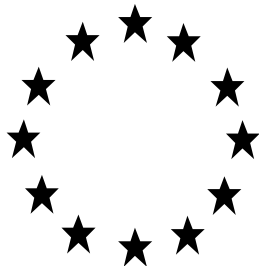
Directive 98/8/EC concerning the placing biocidal products on the market

Inclusion of active substances in Annex I to Directive 98/8/EC

Assessment Report



Didecyldimethylammonium Carbonate / Bicarbonate (DDACarbonate)

Product-type 08 (Wood Preservative)

July 2012

Annex I - UK

Didecyldimethylammonium Carbonate / Bicarbonate (DDACarbonate) (PT 08)

Assessment report

Finalised in the Standing Committee on Biocidal Products at its meeting on 2 March 2012 in view of its inclusion in Annex I to Directive 98/8/EC

CONTENTS

1. STATEMENT OF SUBJECT MATTER AND PURPOSE

1.1. Procedure followed

This assessment report has been established as a result of the evaluation of DDACarbonate as product-type 08 (wood preservative), carried out in the context of the work programme for the review of existing active substances provided for in Article 16(2) of Directive 98/8/EC concerning the placing of biocidal products on the market[1], with a view to the possible inclusion of this substance into Annex I to the Directive.

DDACarbonate (CAS No. 894406-76-9) was notified as a new active substance, by Lonza, hereafter referred to as the applicant, in product-type 08. The UK was chosen as Rapporteur Member State to carry out the assessment on the basis of the dossier submitted by the applicant.

On 17 January 2007 the UK competent authority received a dossier from the applicant. The Rapporteur Member State accepted the dossier as complete for the purpose of evaluation on 4 September 2008.

On 11 November 2010, the Rapporteur Member State submitted to the Commission and the applicant a copy of the evaluation report, hereafter referred to as the competent authority report. The Commission made the report available to all Member States by electronic means on 10 December 2010. The competent authority report included a recommendation for the inclusion of DDACarbonate in Annex I to the Directive for PT 08.

In order to review the competent authority report and the comments received on it, consultations of technical experts from all Member States (peer review) were organised by the Commission. Revisions agreed upon were presented at Technical and Competent Authority meetings and the competent authority report was amended accordingly.

On the basis of the final competent authority report, the Commission proposed the inclusion of DDACarbonate in Annex I to Directive 98/8/EC and consulted the Standing Committee on Biocidal Products on 2 March 2012.

The present assessment report contains the conclusions of the Standing Committee on Biocidal Products, as finalised during its meeting held on 2 March 2012.

1.2. Purpose of the Assessment Report

This assessment report has been developed in support of the decision to include DDACarbonate in Annex I to Directive 98/8/EC for product-type 08. The aim of the assessment report is to facilitate the authorisation in Member States of individual biocidal products in product type 08 that contain DDACarbonate. In their evaluation, Member States

1 Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing biocidal products on the market. OJ L 123, 24.4.98, p.1

shall apply the provisions of Directive 98/8/EC, in particular the provisions of Article 5 as well as the common principles laid down in Annex VI.

For the implementation of the common principles of Annex VI, the content and conclusions of this assessment report, which is available at the Commission website[2], shall be taken into account.

However, where conclusions of this assessment report are based on data protected under the provisions of Directive 98/8/EC, such conclusions may not be used to the benefit of another applicant, unless access to these data has been granted.

1.3. Overall conclusion in the context of Directive 98/8/EC

The overall conclusion from the evaluation is that it may be expected that there are products containing DDACarbonate for the product-type 08, which will fulfil the requirements laid down in Article 10(1) and (2) of Directive 98/8/EC. This conclusion is however subject to:

i. compliance with the particular requirements in the following sections of this assessment report,

ii. the implementation of the provisions of Article 5(1) of Directive 98/8/EC, and

iii. the common principles laid down in Annex VI to Directive 98/8/EC.

Furthermore, these conclusions were reached within the framework of the uses that were proposed and supported by the applicant (see Appendix II). Extension of the use pattern beyond those described will require an evaluation at product authorisation level in order to establish whether the proposed extensions of use will satisfy the requirements of Article 5(1) and of the common principles laid down in Annex VI to Directive 98/8/EC.

2 http://ec.europa.eu/comm/environment/biocides/index.htm

2. OVERALL SUMMARY AND CONCLUSIONS

2.1. Presentation of the Active Substance

2.1.1. Identity, Physico-Chemical Properties and Methods of Analysis

For the majority of toxicological and ecotoxicological endpoints, tests have been conducted on the chemical and structural analogue, Didecyldimethylammonium Chloride (DDAC) and a justification for read across of Didecyldimethylammonium Carbonate/Bicarbonate (DDACarbonate) with data of DDAC is included.

As it was not possible to isolate the technically pure solid, a mixture was prepared for testing the physicochemical properties which contained about 80 % DDACarbonate with residual water and propylene glycol.

The main identification characteristics and the physico-chemical properties of DDACarbonate are given in Appendix I to this document. The active substance must be technically equivalent to the specification given.

Methods of analysis for the active substance as manufactured and for the determination of impurities have been validated. The active ingredient has been determined using an HPLC method. The impurities have been determined using HPLC, GC and titration. Additional validation data are required for some of the methods of analysis used.

The methods of analysis in environmental matrices, as appropriate for the areas of use assessed, have been validated and shown to be sufficiently sensitive with respect to the levels of concern. A confirmatory method of analysis is required for soil.

2.1.2. Intended Uses and Efficacy

The assessment of the biocidal activity of the active substance demonstrates that it has a sufficient level of efficacy against the target organism(s) and the evaluation of the summary data provided in support of the efficacy of the accompanying product, establishes that the product may be expected to be efficacious.

In addition, in order to facilitate the work of Member States in granting or reviewing authorisations, and to apply adequately the provisions of Article 5(1) of Directive 98/8/EC and the common principles laid down in Annex VI of that Directive, the intended uses of the substance, as identified during the evaluation process, are listed in Appendix II.

2.1.3. Classification and Labelling

Current Classification

As DDACarbonate is a new active substance to the EU, there is no current classification assigned according to Annex I of Council Directive 67/548/EEC.

Proposed classification for DDACarbonate based on Directive 67/548/EEC:

Classification	C: Corrosive Xn: Harmful N: Dangerous for the environment
R-phrases	R34: Causes burns R21: Harmful in contact with skin R22: Harmful if swallowed R50: Very toxic to aquatic organisms

Proposed classification for DDACarbonate based on CLP Regulation:

SIGNAL WORD:	DANGER WARNING
Classification:	Skin Corr. 1B Acute Tox. 4 Chronic Category 1
H-Statements:	H314 H312, H302 H410

Proposed classification for biocidal product BCC-10 (contains 10 % DDACarbonate) based on Directive 67/548/EEC:

Classification:	C: Corrosive N: Dangerous for the environment
R-phrases:	R34: Causes burns R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

Proposed classification for biocidal product BCC-10 (contains 10 % DDACarbonate) based on CLP Regulation:

SIGNAL WORD:	DANGER WARNING
Classification:	Skin Corr. 1B Acute category 1 Chronic category 3
H-Statements:	H314 H410

2.2. Summary of the Risk Assessment

2.2.1. Human Health Risk Assessment

The key health effects associated with exposure to DDACarbonate arise due to severe irritation/corrosivity at the initial site of contact as a result of direct chemical reactivity. As a consequence a local risk characterisation is conducted following the principles agreed by the Biocides TM in March 2010 and described in the Technical Guidance Document for Risk Characterisation of Local Effects.

2.2.1.1. Hazard identification

The toxicity of DDACarbonate has not been investigated in humans, although this is not considered to be a data gap. Only acute toxicity studies, a skin irritation study, and a repeated dermal exposure study are available on DDACarbonate itself. No data are available to assess the toxicokinetic profile, skin sensitisation, sub-chronic and chronic toxicity, carcinogenicity and reprotoxicity potential of DDACarbonate. However for these endpoints, data from studies conducted on a structurally-related substance, Didecyldimethylammonium chloride (DDAC) (review active substance) are available.

DDACarbonate and DDAC have an identical quaternary ammonium cation (Didecyldimethylammonium+) and differ in their respective anions (Cl- and CO_3 2-/HCO_3-). Both substances are salts, which in diluted form are completely dissociated. Justification for use of DDAC data to predict the toxicity of DDACarbonate is based on the assumption that the toxicity of both substances is mediated via the quaternary ammonium cation. This assumption is supported by the fact that both anions occur naturally in the body and are subject to tightly regulated homeostatic mechanisms following absorption into the systemic circulation. Anion-mediated toxicity may occur at very high concentrations when the homeostatic processes required for their regulation are overwhelmed but this is unlikely to occur at sub-irritant levels. In addition, where physico-chemical and toxicological data are available for both substances the results from these studies suggest that the toxicodynamic properties of both substances are identical.

The toxicokinetics of DDAC have been investigated in an *in vivo* absorption, distribution, metabolism and excretion study and an *in vitro* percutaneous absorption study. On the basis of these data, the UK CA suggests a value of 40 % for oral absorption and dermal absorption values of either 25 % (≤ 1.85 % DDACarbonate) or 100 % (> 1.85 % DDACarbonate) are derived for DDACarbonate. As no data are available to assess the absorption of DDACarbonate following inhalation exposure, an inhalation absorption value of 100 % is assumed.

Once absorbed, DDAC (and by read across DDACarbonate) is distributed reasonably widely throughout the body and is therefore likely to reach the bone marrow and could also cross the placenta. Exposure via breast milk is unlikely given the non-lipophilic nature of DDAC and DDACarbonate.

Elimination after single or repeated oral administration occurs mainly in the faeces and is largely complete 72 hours after dosing. Levels of radioactivity remaining in the carcass and several major organs following single and repeated administration of radiolabelled DDAC were

similar. This suggests that DDAC/DDACarbonate is unlikely to bio-accumulate on repeated dosing. In male and female rats, most of the radioactivity detected in the faeces was associated with the parent compound but 4 major metabolites, formed as a result of oxidation of the 2 decyl side chains to hydroxyl- and hydroxyketo-derivatives, were also identified following single or repeated oral doses of DDAC. A similar elimination profile is predicted for DDACarbonate.

Acute toxicity data are available for DDACarbonate via the oral and dermal routes. An oral LD_{50} value of 245 mg/kg bw (100 % a.s.) was identified in rats. A dermal LD_{50} value could not be identified as only a single limit dose was applied to the skin of 2 rats. However, since both rats were killed *in extremis* it is considered that the dermal LD_{50} value is < 2000 mg/kg bw (50 % a.s.) equivalent to < 1000 mg/kg bw (100 % a.s.). No studies are available to assess the acute inhalation toxicity of DDACarbonate. Nevertheless, given the corrosive properties of DDACarbonate, it is predicted that this substance will also be acutely toxic via the inhalation route.

Overall, these data support classification of DDACarbonate by the oral and dermal routes.

DDACarbonate (100 % a.s.)

DSD classification: Xn; R21/22

CLP classification: Acute Tox. 3; H301, Acute Tox. 3; H311

DDACarbonate (50 % a.s.)

DSD classification: Xn; R21/22

CLP classification: Acute Tox. 4; H302, Acute Tox. 4; H312

The skin irritant potential of DDACarbonate (50 % a.s.) has been assessed in an OECD guideline study in a rabbit. The severity of the skin response which included necrosis led to the early termination of the study and demonstrated that DDACarbonate is a corrosive substance. These findings are supported by the results from an acute dermal study and a repeated dose study in rats. No data are available to assess the eye or respiratory tract irritation potential of DDACarbonate but it can be predicted that DDACarbonate would also be severely irritating / corrosive when in contact with these tissues. Overall, these data support classification of DDACarbonate (50 % a.s. and 100 % a.s.) with C; R34 (CLP classification: Skin Corr. 1B; H314).

The skin sensitisation potential of DDACarbonate has not been investigated in a standard study but 2 OECD-compliant Buehler studies are available for DDAC (80 % a.s.). DDAC did not induce skin sensitisation. In addition, DDACarbonate (100 % a.s.) did not induce skin sensitisation in a non-standard study. Overall, it is not anticipated that DDACarbonate will induce skin sensitisation and no classification is proposed. No data are available to assess the potential of DDACarbonate to induce respiratory sensitisation. Given that no skin sensitisation potential has been identified DDACarbonate is not expected to cause respiratory sensitisation.

The effects of repeated exposure to DDACarbonate have only been investigated in a limited non-guideline dermal study. However standard repeated dose studies have been conducted using the structurally-related substance DDAC in rats, mice and dogs via the oral route and in rats via the dermal route. The results from the oral studies reveal a pattern of response (local corrosion rapidly followed by signs of generalised toxicity and death) that is consistent with the mode of action of a corrosive substance. Therefore, the systemic effects observed in these studies are regarded as secondary to the local irritation/corrosion caused by the test substance and as a result the NOAELs and LOAELs identified are for the underlying local toxicity. The NOAELs and LOAELs for repeated dose (local) toxicity are summarised in Table 1.1 below. The doses presented below have been adjusted to represent 100 % active ingredient.

Table 1.1 A summary of the NOAELs and LOAELs identified in repeated dose toxicity studies of DDAC and DDACarbonate for the underlying local toxicity of these substances.

Species Route A.S.	**Duration**	**LOAEL (mg/kg bw/day)**	**NOAEL (mg/kg bw/day)**	**Effect(s) at LOAEL**	**Reference**
Rat Oral, diet DDAC	90-days	3000 ppm (daily intakes not calculated but assumed to be ≈ 183 (m) 222 (f))	61 (m) 74 (f)	Mortality	Van Miller 1988a
Mouse Oral, diet DDAC	90-days	182 (m) 224 (f)	107 (m) 134 (f)	Reductions in body weight and body weight gains	Van Miller 1988b
Dog Oral, diet DDAC	90-days	25	7.5	Reductions in body weight and body weight gains	Cox & Bailey 1975
Dog Oral, gavage DDAC	8-weeks 4-weeks	N/A 7.5	N/A < 7.5	Soft mucoid faeces	Osheroff 1990
Dog Oral, gavage DDAC	52-weeks	3	< 3	Reduced food consumption and emesis	Schulze 1991
Rat Oral, diet DDAC	104-weeks	64 (m) 83 (f)	32 (m) 41 (f)	Reductions in body weight and body weight gains, reduced food consumption, histopathological changes in lymph nodes and bile ducts	Gill *et al* 1991a
Mouse Oral, diet DDAC	78-weeks	76 (m) 93 (f)	15 (m) 19 (f)	Reductions in body weight and body weight gains	Gill *et al* 1991b
Rat	90-days	6	2 ≡ 16.5	Erythema/oedema	Gill & Van

Species Route A.S.	**Duration**	**LOAEL (mg/kg bw/day)**	**NOAEL (mg/kg bw/day)**	**Effect(s) at LOAEL**	**Reference**
Dermal DDAC			$\mu g/cm^2$/day	(reversible by day 12) and histopathological changes	Miller 1988
Rat Dermal DDACarbonate	15-days (over 23-day period)	10 $\mu g/cm^2$/day	< 10 $\mu g/cm^2$/day	Very slight erythema	Merkel 2006

In the oral studies, exposure to 3000 ppm DDAC (daily intakes not calculated but assumed to be approximately 3 x the 1000 ppm doses) for 90 days via the diet resulted in 80 % and 97 % mortality in rats (183 (m) and 222 (f) mg/kg bw/day) and mice (546 (m) and 672 (f) mg/kg bw/day) respectively. Fifty percent mortality was observed in dogs exposed to a gavage dose of 60 mg/kg bw/day DDAC for 8 weeks. Other key adverse effects identified in these studies included severe retardation of body weight gain and reduced body weight and food consumption. Dogs also displayed signs of emesis and soft/mucoid faeces. A LOAEL of 7.5 mg/kg bw/day DDAC (100 % a.s.) over a period of 4 weeks (within the 8-week study) was identified in dogs based on the presence of soft mucoid faeces and a LOAEL of 3 mg/kg bw/day DDAC (100 % a.s.) was identified in a 52-week dog study based on the observation of emesis. Limitations were identified in both of these studies; in the 8-week study the dosing procedure was changed from a single daily dose to 2 half doses per day after 2 weeks exposure which may have affected the extent of the observed toxicity and in the 52-week study sickness was observed in the control animals. Despite these uncertainties the UK CA considers that these LOAELs can be used in the risk characterisation because similar adverse effects were observed in each study reducing concern over their reliability. Chronic dietary studies in rats and mice also revealed signs of generalised toxicity, mainly reductions in body weight and body weight gain. However these effects occurred at higher doses than those observed in the sub-acute and sub-chronic studies in dogs. Overall, dogs appear to be more sensitive to the adverse effects of repeated oral exposure to DDAC than rats and mice and toxicity occurs at lower doses in gavage studies compared to dietary studies. Given the underlying mode of action of DDAC/DDACarbonate toxicity (i.e. irritation/corrosion) and the anticipated pattern of oral exposure in humans (infant chewing wood), gavage administration is considered a relevant exposure route for use in the risk characterisation of DDACarbonate.

In a standard 90-day dermal study, no systemic toxicity was observed up to the highest dose tested of 12 mg/kg bw/day DDAC (100 % a.s.). Signs of skin irritation were observed at all doses and the incidence of these lesions increased with increasing dose. At the lowest dose tested, reversible, well defined erythema in 1 female (day 15 only) and epidermitis in 1 female and 1 male were observed. As the erythema was observed in 1 female at 1 time-point only and because the microscopic changes were very mild in nature these effects were not considered adverse and a local toxicity NOAEL of 2 mg/kg bw/day (0.1 % solution) was identified. As local effects are concentration-dependent rather than dose-dependent the NOAEL of 2 mg/kg bw/day has been converted to a concentration-based NOAEC of 16.5 $\mu g/cm^2$/day (see below).

This NOAEC is similar to the LOAEC generated in the non-standard repeated dose study conducted with DDACarbonate (100 % a.s.) in which a local toxicity LOAEC of 10 μg/cm^2/day (0.1 % solution) was identified based on the intermittent presence of very slight erythema in most animals throughout the study.

Conversion of dermal dose to dermal concentration

$$\frac{2 \text{ mg/kg bw/day} \times 0.35 \text{ kg (bw default – TGD)} \times 1000}{42.5^{*}} = 16.5 \ \mu g/cm^2/day$$

*Treated area (cm^2) based on the assumption that 10 % of the body surface area was exposed to DDAC. A default value of 425 cm^2 for total body surface area was used (TGD).

DDACarbonate did not induce gene mutations in bacterial or mammalian cells or induce chromosome aberrations in human lymphocytes *in vitro*. The reliability of the negative result observed in the *in vitro* chromosome aberration study is reduced because in the confirmatory experiment, in the presence of metabolic activation, an insufficient level of cytotoxicity was achieved at the highest concentration tested. However the UK CA notes that the Italian CA has reported a negative result in an OECD-compliant *in vivo* mammalian bone marrow chromosome aberration test for the structurally-related substance DDAC which allays the concern raised in relation to DDACarbonate. Furthermore DDAC was not identified as a carcinogen in two chronic toxicity/carcinogenicity studies (see below). The available data do not support classification for genotoxicity.

The carcinogenicity of DDACarbonate has not been investigated but data are available for DDAC (100 % a.s.). DDAC was not found to be carcinogenic in two OECD-compliant dietary studies performed in rats and mice up to dose levels causing toxicity. On the basis of these data, DDACarbonate is not predicted to be a carcinogen and no classification is proposed.

The reproductive toxicity of DDACarbonate has not been investigated but data are available for the structurally-related substance – DDAC. The developmental toxicity potential of DDAC (100 % a.s.) has been assessed in rats and rabbits in two gavage OECD-compliant studies. No developmental toxicity was observed in the rat at maternally toxic dose levels. A maternal toxicity NOAEL of 1 mg/kg bw/day and a developmental toxicity NOAEL of > 20 mg/kg bw/day were identified from this study. Developmental toxicity was observed in rabbits following exposure to DDAC. The increased incidence of dead foetuses per litter and the reduction in foetal body weight occurred only in the presence of significant maternal toxicity. The absence of developmental toxicity following exposure to a lower dose of DDAC which resulted in less severe maternal toxicity suggests that the developmental effects observed in this study were non-specific and occurred as a consequence of maternal toxicity. A maternal toxicity NOAEL of 1 mg/kg bw/day and a developmental toxicity NOAEL of 3 mg/kg bw/day were identified from this study. As in the repeated dose toxicity studies described above, the results from the developmental toxicity studies reveal a pattern of response (local corrosion

rapidly followed by signs of generalised toxicity and death) that is consistent with the mode of action of a corrosive substance. Therefore the maternal toxicity observed in these studies is regarded as secondary to the local irritation/corrosion caused by DDAC and, as a result, the NOAELs identified are for the underlying local toxicity. On the basis of these data, DDACarbonate is not predicted to cause developmental toxicity and no classification is proposed.

DDAC did not have any effects on fertility or reproductive performance in the F0 or F1 generations of an OECD-compliant 2-generation study when administered in the diet at the highest doses of 79 - 149 mg/kg bw/day (100 % a.s.) in males and 99 - 154 mg/g bw/day (100 % a.s.) in females. NOAELs of 38 mg/kg bw/day were identified in adult rats of each generation based on reduced body weight at the highest dose. On the basis of these data, DDACarbonate is not predicted to cause adverse effects on fertility or reproductive performance. The available information does not support classification for fertility effects.

No clinical signs or changes considered to be indicative of neurotoxicity were observed in the acute studies on DDACarbonate or during the repeated dose toxicity studies for the structurally-related substance DDAC. DDACarbonate is not considered to be neurotoxic.

No data are available in relation to human exposure to DDACarbonate. However information is available for DDAC. All reported cases of DDAC exposure demonstrate the irritant potential of DDAC.

Overall, the toxicological properties of both DDACarbonate and DDAC are characterised by severe irritation and primary tissue damage by corrosion at the site of application (e.g. skin and gastrointestinal tract) in all species and via all exposure routes tested. There are no data for the inhalation route but it can be predicted that DDACarbonate would also be severely irritating/corrosive when in contact with respiratory tract tissue.

The risk characterisation for local effects follows the principles agreed by the Biocides Technical Meeting and described in the Technical Guidance Document for Risk Characterisation of local effects in the absence of systemic effects (2010). A local risk assessment is conducted by comparing external exposure concentrations with the derived Acceptable Exposure Concentration (AEC) which is equivalent to the N(L)OAEC divided by the overall Assessment Factor (AF). Risks are considered acceptable if the exposure concentration is less than the AEC.

In relation to the oral route, LOAELs of 7.5 and 3 mg/kg bw/day for local toxicity were identified from oral gavage studies in the dog exposed to DDAC for 4 and 52 weeks respectively. However, NOAELs of 1 mg/kg bw/day were identified for maternal toxicity and its underlying local toxicity from developmental toxicity studies in the rat and rabbit. These NOAELs are the lowest identified and so they are selected for the derivation of the oral AEC. As local effects tend to be concentration-dependent the concentrations of DDAC at the NOAELs of 1 mg/kg bw/day were identified from the test reports and were stated to be 0.2 mg/ml in the rat study and 0.5 mg/ml in the rabbit study. Depending on the oral exposure metric, a NOAEL of 1 mg/kg bw/day or a NOAEC of 0.2 mg/ml will be used in the local effects risk characterisation of DDACarbonate.

Regarding the dermal route, a NOAEL of 2 mg/kg bw/day (0.1 % solution) was identified in a standard 90-day rat study on DDAC. As local effects tend to be concentration-dependent rather than dose-dependent the NOAEL of 2 mg/kg bw/day has been converted to a concentration-based NOAEC of 16.5 µg/cm^2/day (see above). This NOAEC is similar to the LOAEC established in a 3-week non-standard dermal study of DDACarbonate in which a LOAEC of 10 µg/cm^2/day (0.1 % solution) was identified based on the intermittent presence of very slight erythema in most animals throughout the study. The LOAEC of 10 µg/cm^2/day (0.1%) is selected for the derivation of the dermal AEC.

2.2.1.2. Critical endpoints

The critical effects of both DDACarbonate and DDAC are characterised by severe irritation and primary tissue damage by corrosion at the site of application (e.g. skin and gastrointestinal tract) in all species and via all exposure routes tested. For the risk characterisation of DDACarbonate, the external DDACarbonate concentrations for the oral and dermal routes of exposure will be compared to the relevant route-specific AEC values. The oral AEC is based on a NOAEC for maternal toxicity and its underlying local toxicity. An AEC value for acute, medium-term and chronic oral exposure scenarios of 0.06 mg/ml (equivalent to 0.3 mg/kg bw/day) is proposed based on the NOAEC of 0.2 mg/ml (equivalent to a NOAEL of 1 mg/kg bw/day in the rat) and an intraspecies toxicodynamic assessment factor of 3.2. The dermal AEC is based on a LOAEC for reversible very slight erythema. An AEC value for acute, medium-term and chronic dermal exposure scenarios of 1.6 µg/cm^2/day (0.02 %) is proposed based on the LOAEC of 10 µg/cm^2/day (0.1 %) plus an intraspecies toxicodynamic assessment factor of 3.2 and an additional assessment factor of 2 for extrapolation from a LOAEC. As no data are available to assess the potential of DDACarbonate to cause toxicity via the inhalation route, an AEC can not be calculated for this route of exposure. However, as similar effects are expected by this route, further data are not required as appropriate risk mitigation measures can be employed to prevent inhalation exposure.

Local effect - Oral –

acute, medium-term and chronic AEC = 0.06 mg/ml (0.3 mg/kg bw/day)

Local effect - Dermal –

acute, medium-term and chronic AEC = 1.6 µg/cm^2/day (0.02 %)

2.2.1.2.1. Uncertainties

Dermal Absorption Values Used in the Risk Assessment

No data are available to assess the dermal absorption potential of DDACarbonate. However information is available for DDAC. An *in vitro* dermal absorption study using 1.85 % aqueous solution of DDAC revealed a dermal absorption value of 25 %. This value includes the total amount of radioactivity found in the stratum corneum as data are not available to distinguish between different layers of the stratum corneum; therefore the entire amount of DDAC within the skin is assumed to be systemically available as a worst case scenario. DDACarbonate is predicted to have a similar dermal absorption profile. No data are available to assess dermal absorption of DDAC/DDACarbonate at concentrations > 1.85 %. As DDAC/DDACarbonate is

corrosive with exposure leading to a loss of skin integrity a dermal absorption value of 100 % is proposed for solutions containing > 1.85 % DDACarbonate.

As outlined above a number of uncertainties are associated with these dermal absorption values. However, as only a local effects risk assessment is appropriate for DDACarbonate these dermal absorption values will not be used in the risk characterisation of DDACarbonate.

Inter- and Intra-Species Variability

The toxicity of DDACarbonate is characterised by severe irritation and primary tissue damage by corrosion at the site of application (e.g. skin and gastrointestinal tract). No data are available to assess the relative sensitivities of humans to these local effects compared to experimental animals. However, in accordance with the EC Technical Guidance Document – Risk Characterisation of local effects in the absence of systemic effects (2010), no kinetic assessment factors are proposed for interspecies variability in deriving the oral and dermal AEC values because the local toxicity caused by DDACarbonate is the result of direct chemical reactivity and no kinetic processes are involved. Similarly, no dynamic interspecies assessment factors are proposed as humans are not considered to be more susceptible to the local effects on the skin and the gastrointestinal tract compared to animals. According to the Applicant, DDACarbonate is a cationic surfactant type active substance that reacts directly with the cell walls of microorganisms. This mode of action is most likely to be the underlying mechanism of the observed local toxicity of DDAC/DDACarbonate in mammals. Hence, it is considered that the local toxicity of DDACarbonate is the result of the direct interaction of DDACarbonate with the external membranes of the skin and gastrointestinal tract. In addition it is not considered necessary to include a toxicokinetic factor to account for intraspecies variability because the local effects observed in the animals exposed to DDAC/DDACarbonate do not involve kinetic and metabolic processes. Only, a toxicodynamic assessment factor of 3.2 for intraspecies variability is proposed.

No data are available to assess inhalation toxicity therefore no inter- and intraspecies assessment factors are selected for this route of exposure.

Route to Route Extrapolation

Route to route extrapolation is not appropriate for the risk characterisation of DDACarbonate because only the local irritation/corrosion effects of DDACarbonate caused by local concentrations of DDACarbonate at the site of application are considered relevant to the assessment. For oral and dermal exposure scenarios a direct comparison will be made between the external exposure concentrations and the calculated AEC. As no data are available to assess the potential of DDACarbonate to cause toxicity via the inhalation route an AEC cannot be calculated for this route of exposure. As a consequence, risk mitigation measures must be employed by professionals to prevent inhalation exposure.

Dose-Response/Severity of Key Health Effect

The key health effect associated with exposure to DDACarbonate is severe irritation/corrosion at the initial site of contact.

Oral Exposure Scenarios

The results from the oral repeated dose studies and developmental toxicity studies reveal a pattern of response (local corrosion rapidly followed by signs of generalised toxicity and death) that is consistent with the mode of action of a corrosive substance. Therefore, the systemic effects observed in these studies are regarded as secondary to the local irritation/corrosion caused by the test substance and as a result the NOAELs and LOAELs identified are for the underlying local toxicity. The lowest oral NOAEL (1 mg/kg bw/day DDAC) was identified for maternal toxicity and its underlying local toxicity from developmental toxicity studies in the rat and rabbit. In the rat study a maternal toxicity LOAEL of 10 mg/kg bw/day was identified based on the observation of audible respiration in a number of animals. Audible respiration was also observed at the highest dose of 20 mg/kg bw/day in addition to reductions in body weight gain and stomach ulceration. In the rabbit study a maternal toxicity LOAEL of 3 mg/kg bw/day was identified based on audible respiration and an 80 % reduction in body weight gain during the exposure period. At the highest dose of 10 mg/kg bw/day 25 % mortality was observed. Audible respiration, weight loss and pathological changes in the G.I. tract and respiratory tract were also observed at this dose.

As local effects tend to be concentration-dependent, the concentrations of DDAC at the NOAELs of 1 mg/kg bw/day were identified (from the test reports) as 0.2 mg/ml in the rat study and 0.5 mg/ml in the rabbit study. Depending on the oral exposure metric, a NOAEL of 1 mg/kg bw/day or a NOAEC of 0.2 mg/ml will be used in the local effects risk characterisation of DDACarbonate.

Dermal Exposure Scenarios

In a standard 90-day dermal study, no systemic toxicity was observed up to the highest dose tested of 12 mg/kg bw/day DDAC (100 % a.s.). Signs of skin irritation were observed at all doses. At the lowest dose tested, reversible, well defined erythema in 1 female (day 15 only) and epidermitis in 1 female and 1 male were observed. As the erythema was observed in 1 female at 1 time-point only and because the microscopic changes were very mild in nature these effects were not considered adverse and a local toxicity NOAEL of 2 mg/kg bw/day (0.1 % solution) was identified. At 6 mg/kg bw/day erythema was observed in 2 males and 4 females and oedema was observed in 1 male and 2 females. In addition excoriation was observed in 1 female and epidermitis and dermititis were observed in 4 rats (2 males/2 females) and 7 rats (1 male/6 females) respectively. At the highest dose tested (12 mg/kg bw/day) erythema was observed in 6 males and 14 females and oedema was observed in 1 male and 9 females. Excoriation was observed in 5 females and exfoliation in 1 male and 7 females at this dose. In addition microscopic lesions including epidermitis and dermatitis were observed in 10 (2 males/8 females) and 11 (1 male/10 females) rats respectively. Females in this group also revealed evidence of moderate-severe acanthosis (2/15), focal haemorrhages (1/15), vacuolar degeneration of the epidermis (3/15) and moderate-marked ulceration (2/15). As local effects tend to be concentration-dependent rather than dose-dependent the NOAEL of 2 mg/kg

bw/day has been converted to a concentration-based NOAEC of 16.5 µg/cm^2/day (see Section 1.1.2).

This NOAEC is similar to the LOAEC of 10 µg/cm^2/day (0.1 % solution) identified in a 3-week non-standard dermal study of DDACarbonate (100 % a.s.) which was based on the intermittent presence of very slight erythema in most animals throughout the study. Severe erythema and slight oedema were observed in animals exposed to 20 µg/cm^2/day DDACarbonate on day 5 of the study following progressive increases in severity from day 1. However, following the weekend break in exposure the severity of erythema and oedema was reduced to very slight levels for the remainder of the study. Severe erythema with superficial eschar and slight oedema were observed at concentrations ≥ 30 µg/cm^2/day and exposure of these groups was stopped for humane reasons prior to the 5th application of DDACarbonate. Animals in these groups were killed on day 9 of the study.

The LOAEC of 10 µg/cm^2/day (0.1 %) will be used in the local effects risk characterisation of DDACarbonate. Therefore an additional assessment factor is required in order to estimate the highest no-effect concentration for DDACarbonate in the rat. It is noted that the LOAEC values of 10 µg/cm^2/day DDACarbonate is similar to the NOAEC value of 16.5 µg/cm^2/day DDAC. In addition the intermittent and mild nature of the effects seen at the LOAEC suggests that an additional assessment factor of 2 is appropriate.

Inhalation Exposure Scenarios

No data are available.

Duration Extrapolation

The NOAEL of 1 mg/kg bw/day (equivalent to a NOAEC of 0.2 mg/ml) for the local effects on the gastrointestinal tract was identified following 10-days exposure to DDAC in a rat developmental toxicity study. These effects appear to be concentration-dependent rather than dose (concentration and time)-dependent as shown by the fact that in a much longer study (52-weeks in the dog), similar effects were observed at similar dose levels (LOAEL = 3 mg/kg bw/day); therefore the same acute, medium-term and chronic AEC value will be derived from this short-term NOAEC without the addition of an assessment factor to account for duration extrapolation.

The LOAEC of 10 µg/cm^2/day for local effects of DDACarbonate on the skin was identified following a 3-week exposure in rats. These effects appear to be concentration-dependent rather than dose (concentration and time)-dependent as shown by the fact that in a longer study (90-days) on DDAC, a NOAEC was identified at a similar concentration (NOAEC = 16.5 µg/cm^2/day); therefore the same acute, medium-term and chronic AEC value will be derived from this LOAEC without the addition of an assessment factor to account for duration extrapolation.

2.2.1.3. Exposure assessment

2.2.1.3.1. Primary exposure

Industrial/Professional Users

The PT 8 representative product containing DDACarbonate is to be used in an industrial setting.

Exposure of industrial/professional workers to the active substance DDACarbonate while handling a ready-to-use wood preservation product has been estimated. DDACarbonate may be used to treat outdoor timber and structural timber used for construction. This could include outdoor flooring (decking), door and window frames and internal and external doors.

Human exposure assessment is based on guide formulations, which are representative of typical water-based formulated products. (The product assessed in this dossier is a dummy product and the Applicant is aware that full details of actual products will need to be supplied for assessment at the product authorisation stage).

Water-based treatment solutions will normally be prepared to the required concentration by diluting the concentrate formulation (10 % w/w DDACarbonate) in a closed system. Dilution of 1:10 of the concentrate with water in order to obtain a ready-for-use product at 1 % w/v for professionals can therefore be regarded as a worst case, both with respect to direct assessment of exposure and for leaching from treated wood.

During and after application of DDACarbonate-containing wood preservatives by industrial/professional operators, operator contamination could theoretically occur by dermal and inhalation routes. The potential for oral exposure of operators through ingestion of DDACarbonate during the industrial/professional uses is considered negligible. For the applications considered in this assessment, the inhalation route is of lower concern, relative to the dermal route, because the product is not to be manually sprayed and the active substance has a vapour pressure 7.7×10^{-3} Pa at 25 °C.

The workplace risk for industrial/professional workers will be controlled through observance of statutory requirements such as formal control measures. Generally employees are fully trained and know:

- how and when to apply the control measures;
- the defined methods of work;
- how to use personal protective equipment correctly;
- the cleaning, storage and disposal procedures to be followed, including why they are required and when they are to be carried out; and
- procedures to be followed in an emergency.

All exposure calculations were carried out according to the recommendations of the TNsG - Human Exposure to Biocidal Products 2002, as revised by User Guidance version 1 (EC, 2002a).

In the Tier 1 exposure assessment it is assumed workers generally wear light clothing with a penetration of formulation through clothing to the skin of 100 % - essentially no protection.

In the Tier 2 estimate of dermal exposure, a clothing penetration for coveralls of 10 % (User Guidance, p.42) has been assumed for professionals. Chemical protective coveralls providing limited protection against liquid challenge would be designated Type 6 (EN 13034) provide up to 90 % protection against penetration and permeation. For some exposure scenarios (dipping and cleaning out the dipping tank), where considerable contamination of the operator can be anticipated, workers can be expected to wear protective clothing of such a type and in such a way that it offers a higher degree of protection than typical workwear against the expected higher challenge. A default value of 5 % for clothing penetration has been proposed in a Tier 2 assessment based on the findings from UK HSE surveys (TNsG 2002, Part 2, p 38) where the challenge is "considerable", that is potential dermal exposure to in-use formulation is above 200 mg/minute.

Where no specific data are available for a proposed use, indicative values based on analogous or comparable situations, have been used to calculate exposure.

The following information has been provided by the Applicant with respect to use scenarios of their products.

Mixing and loading stage

The preservative is supplied by tanker or IBCs (Intermediate Bulk Containers usually of 1000 litre capacity) typically as a 10 % w/w concentrate. It is delivered to the holding tank by transfer pipes or hoses and is a closed system. There is the potential for operator exposure to the concentrate when changing the hose coupling from an empty IBC to a full one. Correct procedure performed by trained professionals, results in no exposure. Plant personnel are required to be provided with work clothing and personal protective equipment, e.g. coveralls, protective gloves, safety glasses or goggles and footwear. Such PPE is often required to protect the worker from physical injury resulting from contact with machinery, splinters or falling wood pieces. The concentrate is diluted with water, as appropriate, in the process plant to give a solution to be used for preservation of the wood.

Anti-sapstain treatment

DDACarbonate is likely to be used in an anti-sapstain formulation for protecting freshly felled wood against mould and blue-stain fungal growth during drying or shipment. DDACarbonate is used for this end use at a concentration of approximately 10 % w/w concentrate, diluted to a typical concentration of 1.0 % w/w DDACarbonate, and dip-applied to timber in an industrial setting. This exposure has not been assessed separately and exposures are considered similar to those assessed through application of the worst case modeling for industrial handling of timber for vacuum impregnation though the manual handling aspect is likely to be much less for the anti-sapstain treatment.

Dipping application

This use is described in the OECD ESD for wood preservative (Section 4.2.2.1, 1c, p39). DDACarbonate is used for this end use at a concentration of approximately 10 % w/w concentrate, diluted to a typical concentration of 1.0 % DDACarbonate, and dip-applied to timber at a typical uptake of 15 litres/m^3, to give a retention in wood of 0.15 kg/m^3.

Dipping can be an extensively automated batch process with continuous treatment, or a smaller scale manual process as found in a number of Member States. A pack, or single piece, of wood is submerged into a dipping tank filled with a solution containing the wood preservative. The

wood may be loaded onto automated equipment (e.g. hydraulic elevator) and lowered into a dipping tank or introduced using processes requiring greater contact with process plant. The period of time the wood is submerged varies from a few minutes to an hour, depending on anticipated use of the wood. At the end of treatment the wood may be held over the dipping vat for up to an hour to allow excess preservative to drain. Drips are collected and recycled. The treated wood is then removed for storage and fixation of the preservative in the wood. Automated dipping facilities are enclosed, and are equipped with engineering controls.

Vacuum pressure impregnation

Vacuum pressure impregnation is an extensively automated process used to apply wood preservative using pressure to overcome the resistance of the wood to deep penetration of preservative. The treatment is carried out in airtight cylindrical steel pressure/vacuum vessels. The operations are carried out on a cyclical basis. The total treatment time will vary depending on species of wood and the commodity being treated, but in all instances the treating process remains a closed system. Typically the treatment cycle takes three hours and three cycles a day can be predicted – this is the default position described within the TNsG 2002).

The wood preservative product is supplied as a water-based concentrate, by IBC or bulk tanker to a timber treatment plant. There are approximately 1000 facilities in the EU. The concentrated product is pumped into a storage tank. The concentrate is then diluted with water to the required strength and stored in a storage tank. Dilution of the concentrate with water to produce the timber treatment solution is usually within closed systems and the risk of exposure to the operating personnel is considered slight. The diluted treating solution is impregnated into timber under controlled conditions by vacuum and pressure treatment in the timber treatment plant. Unused preservative is returned to the storage tank. The appropriate model within the TNsG (TNsG 2002, Part 2 p 160, Handling Model 1) contains an element for the mixing and loading phase and that aspect will not be addressed separately.

A typical vacuum pressure treatment schedule for treating wood begins with loading the timber onto ‘bogies’ on a rail track, which are then moved into the treatment cylinder. The vessel door is closed and locked and safety devices, to prevent accidental loss of fluid, are activated. Some plants are automatic in operation.

The packs of timber or larger items such as poles are mechanically moved using fork lift trucks or other means such as on a rail track. The freshly treated timber requires a post-treatment conditioning period before it can be moved from the treatment site. The freshly treated timber is held until its surfaces are dry. This is usually within a contained / protected area on a site that is maintained to prevent loss of treatment product to the environment. This enables post-treatment conditioning to take place under controlled conditions. After the required period has elapsed, the timber can be released into the supply chain where it may be used by professional or non-professional personnel.

Non-professional Users

Not applicable. The product is not intended for use by non-professionals.

2.2.1.3.2. Secondary exposure

Secondary (indirect) exposures occur as a result of treated timber being used in areas accessible to professionals and non-professionals. Treated timber is used where weather resistance is required and exposure occurs for instance in house building. It is also conceivable that treated timbers are used to construct children's climbing frames and scenarios have been modelled to address this possibility. A scenario has been included to model the potential for transfer of DDACarbonate to a non-professional during cleaning of coveralls.

The following acute exposure scenarios have been identified:

a) **Adult non-professional sanding treated wood** (inhalation/dermal exposure).

b) **Infants mouthing treated wood off-cut** (oral exposure).

c) **Inhalation of volatilised residues indoors** (inhalation exposure). The product is to be used to pre-treat outdoor timbers. The product is also to be used to pre-treat structural timbers for interior use (e.g. in roofs) and on window frames and internal/external doors; the latter often being painted/stained shortly before or after installation. DDACarbonate is of low volatility and the worst-case assessment for inhalation of residues volatilised indoors from treated timbers shows risks will be insignificant.

d) **Adult cleaning work clothes at home** (dermal exposure).

The following chronic exposure scenarios have been identified:

a) **Inhalation of volatilised residues indoors** (inhalation route). As for the acute secondary exposure scenario for inhalation of residues volatilised indoors from treated timbers, risks from chronic exposure will be similarly insignificant.

b) **Adult – professional sanding of treated wood** (inhalation/dermal exposure).

c) **Infants playing on (weathered) playground structure and mouthing treated wood** (dermal/oral exposure).

2.2.1.3.3. Combined exposure

With systemic exposure it is usually appropriate to add together exposures via the different routes (oral/dermal/inhalation) to determine a 'combined exposure'. This is not appropriate for assessment of local effects (irritancy) where risk is determined by its acceptability via each individual route separately.

2.2.1.4. Risk characterisation

2.2.1.4.1. Primary exposure

Professional Users

For the applications considered in this assessment, the inhalation route is of lower concern, relative to the dermal route, because the product is not to be manually sprayed and the active substance has a vapour pressure of 7.7×10^{-3} Pa at 25 °C. In fact, the exposure assessment has identified limited or negligible inhalation exposures for the primary exposure scenarios outlined in Table 1.2 below. However, it was not possible to perform a quantitative risk assessment for this route because no toxicity data are available to determine an inhalation AEC.

As a result, respiratory protective equipment is recommended for all scenarios except automated dipping and handling of treated wet wood as in these circumstances inhalation exposure is predicted to be zero.

With regard to dermal exposure, as there are no models to predict the amount of product that could contaminate specified areas of skin, especially when PPE is used, a direct comparison between the concentration of DDACarbonate in the product (concentrate and in-use dilutions) and the dermal AEC (expressed as a concentration) has been made and is presented below. It should be noted that Tier II control measures have no effect on the concentration of DDACarbonate that may come into contact with the skin of the operator compared to Tier I.

Table 1.2 Quantitative dermal local effects risk assessment for professionals

Primary exposure scenario	Concentration of DDACarbonate (%) Tier I	Concentration of DDACarbonate (%) Tier II	Dermal AEC (%)	Exposure concentration/AEC for Tier I and Tier II
Mixing & loading (pumping) in a closed system	10	10	0.02	500
Mixing & loading (pouring) in a closed system	10	10	0.02	500
Manual dipping wooden articles	1	1	0.02	50
Automated dipping	1	1	0.02	50
Vacuum pressure impregnation	0.37	0.37	0.02	18.5
Handling of treated wet wood	0.37	0.37	0.02	18.5
Cleaning out dipping tank	1	1	0.02	50

As shown in Table 1.2, risks for local effects on the skin are identified for all scenarios.

According to the Technical Guidance Document for Risk Characterisation of local effects (2010), when the only local effects are minor irritant effects, these will not be sufficient to

justify an Annex I non-inclusion of the active substance even when exposure exceeds the AEC. This conclusion requires that reversibility of the effect can be assumed and exposure intervals allow healing and/or measures can be taken if irritation occurs.

The Technical Guidance Document for Risk Characterisation of local effects (2010) also states that exceeding the dermal AEC up to 10-fold may be considered acceptable on a case-by-case basis. The Rapporteur considers that the methodological problems identified at TM regarding risk assessment for local dermal effects should be taken into account when considering the appropriateness of DDACarbonate for use in biocidal products. Exposure concentrations for DDACarbonate exceed the dermal AEC more than 10-fold for all scenarios in both the Tier I and Tier II assessments. However, these risks result from a simple comparison of the dermal AEC to the in-use concentrations of DDACarbonate. The Tier II risk assessments performed specifically for DDACarbonate, and the exposure concentration/AEC ratios generated by this method, do not take into account the protection provided by the Tier II control measures or their capacity to mitigate the likelihood of exposure. For example, the high exposure/AEC ratios of 500 identified for both mixing and loading scenarios (pumping and pouring) are associated with the operation of a closed system. Hence, the apparent high risks identified for these scenarios are, in practice, highly unlikely to occur. These examples highlight some of the problems associated with current quantitative risk assessments for dermal local effects and will be used to inform ongoing discussions on the refinement of the available methodology.

Therefore, despite the apparent risks identified for all scenarios, even at Tier II, the actual likelihood of exposure/skin contact together with a number of other factors, have been taken into account to justify Annex I inclusion. These considerations include:

1. Potential exposure to the corrosive concentrated product (10 %) during mixing and loading, and therefore the potential to exceed the dermal AEC by > 100 times, is only possible if mistakes are made when changing the hose coupling from an empty Intermediate Bulk Container to a full one. Correct procedure results in no exposure as the system is fully enclosed.

2. Exposure to the in-use concentration (1 % and below) during application will lead to the dermal AEC being exceeded by > 10 times. However, this concentration is irritant, not corrosive. Irritant effects are mild, reversible and immediate with no long-term consequences. They are also easy to monitor. In addition, the user/operator can eliminate the exposure by washing the affected area as soon as the irritant sensation is felt and so exposure is rarely continuous/repeated.

3. The dermal AEC is based on the identification of signs of minimal irritation in a repeated dose animal study, which is likely to overestimate the risk of an acute effect in workers.

4. To minimise exposure by both dermal and inhalation routes, additional risk mitigation measures have been proposed. A recommendation for additional PPE over and above that taken into account by the Tier II assessment (e.g. generic gloves and coveralls as described in the TNsG) has been made, i.e. chemically and mechanically resistant gloves and boots, goggles/faceshield, chemically resistant coveralls or aprons, and if appropriate, suitable respiratory equipment and use of gauntlet gloves.

5. It has been recommended that gloves and coveralls are changed frequently.

6. A skin surveillance scheme to show that the risk mitigation measures are working has been proposed. If problems are identified, additional measures should be applied in line with good practice procedures such as introduction of engineering controls.

7. Only trained professionals with a clear understanding of the risks involved and the appropriate risk mitigation measures that are necessary to prevent/minimise exposure will use the DDACarbonate product and only in an industrial setting.

Overall, if the principles of good working practice are applied and product label instructions and recommendations respected, the risks to professional users are acceptable.

Non-Professional Users

Not applicable. The product is not intended for use by non-professionals.

2.2.1.4.2. Secondary exposure

A number of acute secondary exposure scenarios have been considered (see Table 1.3).

Table 1.3 – Summary of secondary exposure scenarios

Secondary exposure scenario		**Concentration of DDACarbonate**	**AEC Value**	**Acceptable risk?**
Acute exposure scenarios	Adult non-professional sanding treated wood (inhalation)	0.026 mg/m^3 (2.6 x 10^{-8} mg/ml)	-	See text below
	Adult non-professional sanding treated wood (dermal)	0.82 µg/cm^2	1.6 µg/cm^2	Yes
	Infant mouthing treated wood (oral)	Vacuum pressure impregnated wood: 0.0207 mg/ml stimulated saliva	0.06 mg/ml	Yes
	Adult cleaning work clothes (dermal)	3.54 µg/cm^2	1.6 µg/cm^2	No - see text below

Secondary exposure scenario		Concentration of DDACarbonate	AEC Value	Acceptable risk?
	Inhalation of volatilised residues indoors (inhalation)	2.2 mg/m^3 Maximum possible exposure at 25°C	0.06 mg/ml	Yes
Chronic exposure scenarios	Adult professional sanding treated wood (inhalation)	0.026 mg/m^3 (2.6 x 10^{-8} mg/ml)	-	See text below
	Adult professional sanding treated wood (dermal)	0.82 µg/cm^2	1.6 µg/cm^2	Yes
	Infants playing (dermal)	0.001 mg on exposed skin 0.005 µg/cm^2	1.6 µg/cm^2	Yes
	Infants playing (oral)	0.00093 mg/ml saliva via oral route	0.06 mg/ml	Yes
	Inhalation of volatilised residues indoors (inhalation)	2.2 mg/m^3 Maximum possible exposure at 25°C	0.06 mg/ml	Yes

For an adult sanding treated wood, acute dermal and inhalation exposures are expected. The predicted dermal exposure concentration is 0.82 µg/cm^2, below the dermal AEC of 1.6 µg/cm^2. The predicted inhalation exposure is 0.026 mg/m^3 (2.6 x 10^{-8} mg/ml) and no data are available to calculate an inhalation AEC value. However, the oral AEC value is 0.06 mg/ml, and although route-to-route extrapolation for local effects should normally be avoided due to uncertainties related to the difference of site of contact sensitivity, it is considered that these concerns are alleviated by the considerable margin of safety of 23 x 10^5 between the exposure estimate of 2.6 x 10^{-8} mg/ml and the NOAEC of 0.2 mg/ml (oral AEC being 0.06 mg/ml). Therefore, the risk from exposure to DDACarbonate in this scenario is considered to be acceptable.

For an infant mouthing vacuum pressure-treated wood, the calculated oral concentration is below the oral AEC value of 0.06 mg a.s./ml therefore the risk is acceptable.

For an adult cleaning clothes, the predicted dermal exposure concentration is above the AEC (3.54 µg/cm^2 versus 1.6 µg/cm^2, respectively). However, in reality, at large scale dipping

operations all laundry will be professionally cleaned therefore, the UK CA consider that measures will be in place to ensure that exposures will be prevented and so this is not considered to represent an unacceptable risk. Exposure may occur to those workers involved in smaller scale dipping operations. However, the predicted exposure concentration is very much a worst-case estimate and the dermal AEC is based on only very slight irritation.

A number of chronic exposure scenarios have also been considered and all are considered to show the risk of secondary exposure to DDACarbonate is acceptable.

For a professional sanding treated wood, acute dermal and inhalation exposures are expected. The predicted dermal exposure concentration of 0.82 µg/cm^2 is below the dermal AEC of 1.6 µg/cm^2 and it is assumed that a suitable mask will be worn to prevent significant exposure by inhalation. In the absence of RPE exposure to DDACarbonate by the inhalation route will be via inhalation of wood dust particles. In the absence of appropriate data from which to derive an inhalation AEC, inhalation exposure is compared with the oral AEC. Although route-to-route extrapolation for local effects should normally be avoided due to uncertainties related to the difference of site of contact sensitivity, we consider that these concerns are alleviated by the considerable margin of safety of 23 x 10^5 between the exposure estimate of 0.026 mg/m^3 (2.6 x 10^{-8} mg/ml) and the NOAEC of 0.2 mg/ml (oral AEC being 0.06 mg/ml). Therefore, the risk from exposure to DDACarbonate in this scenario is considered acceptable.

For infants playing on a playground structure, dermal and oral exposures are predicted to occur. The predicted dermal exposure of 0.005 µg/cm^2 is below the dermal AEC of 1.6 µg/cm^2; while the predicted oral exposure concentration is 0.00093 mg/ml, below the oral AEC of 0.06 mg/ml.

2.2.1.4.3. Combined exposure

With systemic exposure it is usually appropriate to add together exposures via the different routes (oral/dermal/inhalation) to determine a 'combined exposure'. This is not appropriate for assessment of local effects (irritancy) where risk is determined by its acceptability via each individual route separately.

2.2.2. Environmental Risk Assessment

The active substance DDACarbonate contains the same didecyldimethylammonium cation as the active substance DDAC (also known as DDAChloride). Only the anion differs between the two active substances, being CO_3^{2-} (associated with two cations) or HCO_3^- for DDACarbonate, or Cl^- for DDAC. The Applicant detailed physical/ chemical property data for the two a.s. (DDACarbonate and DDAC) which supported extrapolation of data from DDAC to DDACarbonate.

The information relating to environmental fate is reproduced in Table 2.1a below. While the values for water solubility, vapour pressure, the Henrys Law constant and log K_{ow} do not exactly match each other, the vapour pressures of the two a.s. indicate that both DDACarbonate and DDAC are non-volatile. The values for vapour pressure for the two substances were measured at different temperatures, which may explain some of the difference between them. In addition, differences in the Henrys Law constant can also be attributed to differences in the

measured vapour pressures. The water solubility values for the two a.s. are of the same order of magnitude, and indicate that both are highly soluble in water. Finally although the log K_{ow} values differ slightly both are low and would indicate minimal bioaccumulation. Therefore, all of the measured physical chemical properties are similar to each other and all support extrapolation from DDAC to DDACarbonate. Additionally both active substances are considered to be readily biodegradable under the conditions of the test, which further supports the extrapolation of data from studies conducted with DDAC to DDACarbonate.

Table 2.1a: Environmental fate: Bridging studies DDACarbonate - DDAC

Study	DDACarbonate [a.s.]	DDAC
Vapour pressure	7.7×10^{-3} Pa [25 °C] Non volatile	5.9×10^{-6} Pa [20 °C] Non volatile
Solubility (water)	796 g/l [20 °C] Highly soluble	500 g/l [20 °C] Highly soluble
Log K_{ow}	0.053 [calculated]	-0.301 [calculated]
Hydrolysis	No data [predicted to be stable]	Measured Hydrolytically stable
Biodegradation	85 – 100 %; OECD 301B Readily biodegradable	77.5 %; OECD 301B Readily biodegradable
Henry's constant	1.78×10^{-6} Pa m^3/mol	4.27×10^{-9} Pa m^3/mol
Adsorption	No data Predicted K_{oc} = 1096000	Measured K_{oc} > 400000

Therefore although some of the environmental data requirements for DDACarbonate as a wood preservative (product type 8) were addressed by studies conducted with DDACarbonate, some data requirements were also assessed by extrapolation from studies which were conducted with DDAC (for human health), and which were assessed in the CAR for DDAC [review active substance]. Studies were carried out using DDACarbonate concentrate (approximately 83 % w/w DDACarbonate) or DDAC or the DDAC formulations Dodigen 1881, Bardac 2280, Bardac 22 (approximately 100 %, 80 %, and 50 % w/w DDAC respectively). The DDACarbonate formulations used have been accepted by the UK CA as sufficiently representative, while those for DDAC were accepted as part of the review of DDAC.

Because some of the Ecotoxicology and Environmental Fate studies were conducted using DDAC instead of DDACarbonate, all endpoints are converted to the DDA^+ ion as this is the active component of both substances. The conversion factors are as follows:

For DDACarbonate to DDA^+ the conversion factor is 0.86
For DDAChloride to DDA^+ the conversion factor is 0.902

Conversion factors were calculated based upon the molecular weights of DDAChloride (DDAC), DDACarbonate (Carboquat), and the DDA^+ ion. The molecular weights used were 362.1 g/ mol for DDAC and 326.6 g/ mol for DDA^+. The molecular weight for DDACarbonate is more complicated to determine as it exists as a ratio of DDACarbonate (molecular weight 713.3 g/ mol which in terms of molar basis for cation = 356.6 g/ mol (= 713.3/2)) and DDAbicarbonate (molecular weight 387.6 g/ mol). The ratio of DDACarbonate:

DDAbicarbonate was determined as 20: 80 and therefore a mean molecular weight of 381.3 g/ mol was calculated.

2.2.2.1. Fate and distribution in the environment

FATE IN THE AQUATIC COMPARTMENT

From abiotic aquatic degradation data, it was concluded that DDACarbonate was essentially hydrolytically and photolytically stable based upon tests conducted with DDAC. DT_{50} values from the hydrolysis test were ≥ 175 days for tests conducted at pH values of 5 – 9. No degradation was observed in the direct photolysis test and a DT50 of 227 d was reported for the indirect photolysis study also conducted with DDAC. Under biotic conditions DDACarbonate was classified as readily biodegradable based upon the key study of Fiebig (2008) a ready biodegradability study conducted with the active substance DDACarbonate. The conclusion of this study was supported by the results of four ready biodegradability studies conducted with DDAC which showed that DDAC was readily biodegradable.

Data from a laboratory water/ sediment study conducted with DDAC and a natural water/ sediment system indicated that the active substance rapidly partitions from the water phase to sediment (water phase $DissT_{50} \leq 0.05$ d and $DissT_{90} \leq 6.7$ d under conditions of the test) where degradation was slow (the DT_{50} in sediment phase could not be calculated as it exceeded the test duration of 120 days). The strength of the adsorption to sediment was considered in the DDAC CAR to be due to the didecyldimethylammonium cation having a strong affinity for the negatively charged surface of sediments. The high degree of sorption observed in the water/ sediment study is supported by the high K_{foc} value calculated from the adsorption/ desorption study conducted with DDAC (See 'Fate in Soil' section below).

No major metabolites were identified.

FATE IN AIR

The air compartment was not considered to be a major compartment of concern for this active substance, based on its vapour pressure (7.7×10^{-3} Pa at 25 °C). In addition the lifetime of DDACarbonate in air was predicted to be short based upon the calculated atmospheric half-life of 8.314 hours using the Atkinson calculation and a 24 hour mean OH radical concentration of 5×10^{5} OH radicals cm^{-3}.

FATE IN SOIL

Since DDACarbonate is considered to be readily biodegradable based on the results of the study of Fiebig (2008) conducted with DDACarbonate and supported by ready biodegradation studies conducted with DDAC, no information was submitted or required for the aerobic degradation in soil of DDACarbonate.

A non-key study using DDAC (Schmidt, 1992) was submitted in support of DDACarbonate and reported half-lives of 132 d (exposed test) and 169 d (non-exposed test). The UK CA recalculated the rate of degradation due to photolysis alone as 0.00115 d^{-1}, from which a photolysis half-life of 603 d was calculated assuming single first order kinetics. Therefore considering the study of Schmidt (1992) along with the results of the Dykes and Fennessey

(1989b) study for aqueous photolysis the UK CA concluded that that photolysis on the soil surface will not be a significant route of degradation of the active substance DDACarbonate.

The mean estimated adsorption K_{foc} value for DDAC from a laboratory study conducted with that active was calculated as 1350871 mL/g by the UK CA. The lowest value from the same study was 387931 mL/g. This worst case value, rounded to 400000 mL/g, was used in risk assessments for DDACarbonate. The high degree of sorption indicated by the value also supports the rapid partition.

2.2.2.2. Effects assessment

Some of the Ecotoxicology and Environmental Fate studies were conducted using DDAC instead of DDACarbonate. Therefore all endpoints are converted to the DDA+ ion as this is the active component of both substances. The conversion factors are as follows:

For DDACarbonate to DDA+ the conversion factor is 0.86
For DDAChloride to DDA+ the conversion factor is 0.902

No evidence has been seen to suggest DDACarbonate causes endocrine disruption.

AQUATIC TOXICITY

In the aquatic environment, toxicity of DDACarbonate has been investigated where appropriate. For STP microorganisms it has been assumed that exposure would be mainly to the a.s. and a 3 hour microbial inhibition test reported an EC_{50} of 51 µg l^{-1}. Data on short and long-term toxicity of DDACarbonate to aquatic organisms are available with the most sensitive endpoint reported to be the 72 hr NOEC of 0.013 mg l^{-1} (corrected to DDA+) for the algae, *D. subspicatus*. The PNEC for DDACarbonate was derived using an assessment factor (AF) of 10 to give 1.3 µg l^{-1}.

Sediment toxicity data were available both freshwater and marine sediment dwelling invertebrates for DDACarbonate. The lowest endpoint comes from the marine species, *L. plumulosus*, with an EC50 of 22.36 mg kg^{-1} (corrected to DDA+). The $PNEC_{sediment}$ was calculated from the toxicity data with an assessment factor of 1000. This gives a PNEC of 0.02236 mg kg^{-1} dw sediment. An effects endpoint for the risk assessment (predicted no effect concentration or $PNEC_{sediment}$) was also calculated using the equilibrium partitioning method. The $PNEC_{sediment}$ using this method was determined to be 11.131 mg kg^{-1} dw sediment. The lower of the endpoints from the two methods (0.02236 mg kg^{-1} dw sediment) will be used for the risk assessment.

TERRESTRIAL TOXICITY

In the soil compartment, endpoints are available on toxicity of DDACarbonate to terrestrial plants, earthworms and terrestrial microorganisms. The lowest endpoint is the EC50 for

terrestrial plants (with mustard giving the critical endpoint) which is 255 mg kg^{-1} dw soil (corrected to DDA+).

According to the TGD when data are available from short term toxicity tests (e.g. plants, earthworms, or microorganisms) an Assessment Factor of 1000 should be used to derive the PNEC. The lowest endpoint is the EC_{50} for terrestrial plants of 255 mg kg^{-1} dw soil, which gives a PNEC of 0.255 mg kg^{-1} dw soil.

2.2.2.3. PBT assessment

According to the TGD, 'The Persistent, Bioaccumulative and Toxic (PBT) assessment is considered to be different from the local and regional assessments approaches, as it seeks to protect ecosystems where risks are more difficult to estimate'. Under the Biocidal Products Directive (BPD), a PBT assessment is needed to demonstrate that a substance does not fulfil selection under the United Nations Environment Programme – Persistent Organic Pollutants convention (UNEP-POPs) to limit emissions to the environment of those chemicals with high potential for persistence, bioaccumulation, long-range transport and adverse effects to human health and the environment. Any substance which is found to be either a PBT or very Persistent very Bioaccumulative (vPvB) substance shall not be allowed on Annex I unless releases to the environment can be effectively prevented.

PERSISTENCE: A substance is considered to be persistent if it has a half life > 60 d in marine water or > 40 d in freshwater, or a half-life > 180 d in marine sediment or > 120 d in freshwater sediment. It is considered very persistent if it has a half life > 60 d in marine or freshwater or > 180 d in marine or freshwater sediment. The ready biodegradation studies conducted with both DDACarbonate and DDAC indicate that DDACarbonate is readily biodegradable. Though there were issues associated with the study which meant that it was considered as 'acceptable as supporting information only', the water/ sediment study of de Vette, *et al.* (2000) that was conducted with DDAC, displayed rapid partitioning from the water to the sediment phase where there was a high degree of persistence, though it was concluded that sediment DT_{50} values could not be calculated because 50 % degradation of the active substance in sediment was not reached by the study termination at 120 d. Given the rapid initial partitioning from water to sediment observed (peak sediment concentrations from 1 – 7 days; water phase $DissT_{50} \leq 0.05$ d and $DissT_{90} \leq 6.7$ d under conditions of the test) the sediment DT_{50} value may be > 120 days, and may also be substantially longer. Therefore the UK CA further considered that there was evidence to suggest that DDACarbonate may be (very) persistent in sediment according to the presented criteria. Overall, in the absence of further reliable data the UK CA considered that DDACarbonate should be classified as very persistent (vP) in sediment, until further data are supplied to either confirm or disprove this classification.

Following the peer review process, concern was expressed by another MS that because of the high degree of sorption exhibited by DDACarbonate, its DT_{50} in soil may be longer than the 30 d default value used in the risk assessment. The 30 d value was based upon the ready biodegradation study. Noting that DDACarbonate is an ionic compound (rather than the organic molecules usually considered and for which guidance was designed), the UK considered that DDACarbonate may or may not follow the assumptions usually considered appropriate. However, the UK CA considered that a Koc value of 400000 L/kg is indicative of the sorption of DDACarbonate in the soil compartment, and therefore there may be uncertainty

around the 30 d value used and DDACarbonate may indeed be persistent in soil. Therefore MS may wish to request further data at the product authorisation stage in order to clarify whether DDACarbonate is persistent in soil.

BIOACCUMULATION: A substance is considered to have the potential to fulfil the criterion of bioaccumulation when the log Kow exceeds 3, but as a calculated log Kow of 0.053 has been derived for DDACarbonate bioaccumulation is not expected. However, since the surface tension of DDACarbonate is 31.1 mN/m at 21.4 ± 0.5°C (1.06 g/L aqueous solution), which is less than 50 mN/m an assessment of the potential for bioconcentration was conducted. The BCF_{fish} is 81 mg $kg_{wet\ fish}^{-1}$ which is less than 2000. Therefore, the bioaccumulation criterion is not fulfilled.

TOXIC: According to the available data, the most sensitive chronic endpoint for DDACarbonate is that derived for a 72 hr algal (*D. Subspicatus*) study (NOEC of 0.013 mg l^{-1} (corrected to DDA+)). This means that the trigger of < 0.01 mg l^{-1} given in the TGD is not exceeded and DDACarbonate does not fulfil the toxic criterion.

As DDACarbonate has only fulfilled one criterion out of the 3 considered, it can be accepted that it is not a PBT substance.

2.2.2.4. Exposure assessment

The exposure assessment was based on all available guidance presented in the Organisation for Economic Co-operation and Development (OECD) Emission Scenario Document (ESD) on wood preservatives (OECD, 2003) and TGD on risk assessment.

The OECD ESD guidance is limited to local exposure calculations for the wood preservative life-cycle stages of ‘product application’ and ‘wood in-service’ only. Production of the active substance (a.s.), formulation of the wood preservative product, waste treatment, recovery (out-of-service use) and contamination of treatment sites have not been addressed for DDACarbonate. The local scale exposure assessments presented in this document are considered worst-case in terms of environmental concentrations for this product type and substance. Where a particular Member State concern exists, it is recommended that a detailed consideration of this should be possible at the product authorisation stage.

DDACarbonate is to be used as a wood preservative, in water based products, for use up to use class 4a as defined in OECD ESD (wood in contact with ground permanently exposed to wetting). These wood preservative products are intended for use by professional/industrial users by dipping end use timber products in joineries or in industrial application methods; vacuum pressure and dipping of wooden articles. They are not intended to be applied in-situ, and therefore in-situ application scenarios (e.g. brushing of a fence, house or bridge over a pond) have not been considered as part of this risk assessment.

Emissions to the environment have been considered to occur during industrial scale application and subsequent storage, and leaching during the in-service life-stage of treated wooden articles. For the intended use of DDACarbonate as an a.s. in wood preservatives, the environmental risk assessment scenarios which have been considered for the ‘in-service leaching from treated wood’ are:

a. Fence
b. Noise barrier
c. Timber cladded house
d. Pole
e. Post
f. Jetty
g. Waterway
h. Wharf

In addition to the scenarios given above, use of pre-treated timber in internal roof spaces (UC1 & 2) is likely, which may result in the direct exposure of roosting animals (e.g. birds and bats). In the UK, bats are a protected species and all products that can be used in areas where bats are known to roost (i.e. lofts and roof spaces) undergo a specific risk assessment. An assessment of the risk posed to bats by the use of DDACarbonate in wood preservatives has not been carried out as part of this review but has been deferred to the product authorisation stage, where specific Member States' concerns should be addressed.

The regional concentrations for the proposed use patterns of DDACarbonate have not been addressed as the wood preservative uses outlined are not considered to be of a sufficiently large enough scale to warrant such prediction. In addition, the UK CA considers that the available guidance is too generic and not sufficiently realistic to predict the regional concentrations for wood preservative products and considers that any Member State concerns should be addressed at the product authorisation stage. Furthermore, the local scale assessments that have been conducted are considered to be sufficiently worst case for the purposes of assessing the potential environmental risks posed by the various uses of DDACarbonate as a wood preservative.

2.2.2.5. Risk characterisation

The following environmental risk characterisation sections address the risks posed from DDACarbonate for the environmental compartments of concern based on the proposed patterns of use.

AQUATIC COMPARTMENT

STP

It is considered that losses via drains would result in exposure of sewage treatment plants (STP) to the parent compound only. The risk to the STP (microorganisms) has been assessed following releases during industrial applications and in-service leaching from a noise barrier and in all scenarios the risk quotient (PEC:PNEC) was acceptable (< 1) using the amended

Bestari (2001) data. Therefore, no risk mitigation measures are required to protect this compartment.

Surface Waters (including sediment)

Industrial Processes

Emissions to surface waters from industrial treatment processes (application [via STP] + run-off from on-site stored timber) were not shown to be acceptable in terms of risk from DDACarbonate exposure. However, refined PECs have been calculated which consider the degradation in a STP and in the water body, although partitioning to sludge in the STP and sediment in the water body has not been considered.

Following this refinement the risk for vacuum pressure treatment use classes (UC) 2 & 3 was shown to be acceptable. However, the risk following the dipping treatment for UC 2 & 3 and for the vacuum treatment for UC 4 was still unacceptable, even with refinement. In addition, an unacceptable risk to the sediment compartment was predicted for DDACarbonate for all industrial processes tested (UC 2, 3 & 4). Therefore, mitigation measures are proposed, which would restrict the use of DDACarbonate wood preservative products to industrial wood treatment sites that can comply with the following requirements, intended to prevent losses of treatment solution and leachate to the aquatic environment and therefore result in acceptable risks:

- Application processes must be carried out within a contained area;
    - Situated on impermeable hard standing,
    - With bunding to prevent run-off and
    - A recovery system in place (e.g. sump).
- Storage of freshly treated wood must be either;
    - Undercover with a recovery system in place (e.g. sump) or
    - On impermeable hard standing and bunded to prevent run-off with a recovery system in place (e.g. sump).

These measures are considered a reasonable requirement for all industrial wood treatment sites to prevent unnecessary contamination of the environment. They are common to best available practice (BAP) throughout much of the existing industry in many Member States.

In-service leaching

For the bridge over a pond scenario, all of the assessments predicted an unacceptable risk to the water compartment (including sediment), suggesting that use of DDACarbonate to treat structures over small water bodies (i.e. ponds) should be prevented, which could be achieved through appropriate product labelling. However, the bridge scenario is not considered representative of a common use pattern for wood preservatives by the UK CA and the size of the water body (20 m^3) is considered to be relatively small. The UK CA also questions the

ecological relevance of such a small body of water that is more likely to represent a large ornamental (man-made) pond, which should not be the focus of environmental protection under the BPD.

In plant protection product (PPP) risk assessments in the EU and the UK the standard first tier ditch and stream dimensions adjacent to a field are 100m x 1m x 0.3m, therefore the water bodies have a volume of 30 m^3. This is comparable to the value in the bridge over a pond scenario. However, a ditch or a stream has a flow associated with it and removal can be considered via this process as higher tier refinement. Therefore, the ditch next to a treated field is a different scenario to a bridge over a pond with a different water body and associated characteristics and different exposure and removal pathways. The ditch is considered to be representative of an ecologically relevant water body, while the pond in the bridge over a pond scenario, as indicated above, is not in the opinion of the UK CA. The size of ponds which are used in PPP assessments are much larger than that in the bridge over a pond scenario. In FOCUS SW used in EU assessments the assumed pond volume is a minimum of 900 m^3. A recent examination of the relevance of FOCUS SW to the UK indicated that the pond volume for UK PPP regulatory assessments should be more like half that figure, at approx. 450 m^3. The urban SUDS pond used in the UK HardSPEC scenario assessment for applications to hard surfaces is 3795 m^3. All of these water bodies are considered by the UK CA to be realistic worst cases for the scenarios in which they are in for use in regulatory assessments. All are much larger than the 20 m^3 assumed in this scenario and are considered as being ecologically relevant. Therefore all support the assumption that a natural ecologically relevant pond would be much larger than the 20 m^3 assumed in the bridge over a pond calculation. Therefore based on the above it would seem that there are grounds for either a significant increase in the water body size in this scenario, or a complete revision of the scenario to include flow in the water body.

For the noise barrier scenario, long-term aquatic exposure (excluding sediment) to DDACarbonate from timber dipping or vacuum pressure treatment was shown to be acceptable. In addition the noise barrier scenario displayed a long-term aquatic exposure of sediment to DDACarbonate from timber pre-treated by vacuum treatment that was acceptable. However, the risk was not shown to be acceptable to sediment from the dipping treatment. For this scenario the PEC calculation assumed that in the sewage treatment works there was no partitioning to sludge. This is a reasonable first tier assumption because DDACarbonate will only be in the treatment works for about 3 hours. However, the DT50 for DDAC in a water sediment system was only 1.7 hours (de Vette (2000), and the Koc of DDAC is high, being 400000 L/kg. Because the high Koc value is contradicted by the log Kow of 0.053 the UK CA used the log Kow value in STP emission considerations as a worst case to maximise concentrations in the aqueous phase of the STP effluent. However, the UK CA considers that it is likely that there will be some loss to the sludge compartment in the STP, therefore the presented sediment PECs are considered conservative by the UK CA.

An acceptable risk to surface waters (not including sediment) was found for the jetty, piling and harbour scenarios (the piling scenario had shown an unacceptable risk at Time 1, but an acceptable risk to surface waters at Time 2). However, the exposure of the sediment compartment to DDACarbonate was unacceptable for all three scenarios.

Overall, no further risk mitigation for end-use of timber products with respect to the aquatic environment is considered necessary for use class 3 (vacuum treated) but further risk mitigation is required for use class 3 (dipping) and use class 4 where an acceptable risk to sediment has not been demonstrated.

The UK CA considers that restrictions for end-use of pre-treated timber are not practical beyond those already associated with the hazard classification scheme for treated wood (HC 1-4) and no further restrictions are recommended.

In addition the UK CA considers that a further wood leaching study is required to produce more accurate PEC values. Such a study should address the lack of direct information for timber treated by the dipping method. The UK CA also considers that the study should be conducted for a longer time period than that already available for both vacuum impregnation and dipping treatments in order to refine the risk assessment for TIME 2 assessments. The UK CA further considers that such a study could be used by member states to calculate more appropriate PEC values at product registration.

A summary of scenario acceptability for the Time 2 risk assessments following risk mitigation is shown in Table 2.1 in the 'Summary' subsection below.

TERRESTRIAL COMPARTMENT

Industrial Processes

The use of DDACarbonate in all industrial scenarios has been shown to present an unacceptable risk (PEC:PNEC > 1) to the soil compartment, after short and long-term use. Whilst this reflects the lack of degradation within the scenario, continuous losses to soil should not be permitted. Therefore, to minimise this risk, all timber treated with DDACarbonate-based products should be stored on bunded, impermeable ground and any waste collected for re-cycling or waste disposal. This requirement is identical as that for preventing losses from industrial processes to the aquatic environment (see aquatic compartment, page 29) and is considered to reinforce current BAP throughout the industry.

In-service leaching

Unacceptable risks to the soil compartment from DDACarbonate have been identified following the short and long-term worst case assessments for most of the in-service leaching scenarios for use class 3 and 4 (outdoors, out-of-ground contact and outdoors, in-ground contact) scenarios. However, a refined realistic worst case risk assessment (which used refined PECs calculated by considering degradation in soil) showed no unacceptable risks from vacuum pressure treated wood for either use class 3 or 4 scenarios. The use class 3 dipping treatment showed unacceptable risks for all scenarios.

A summary of scenario acceptability for the Time 2 risk assessments following risk mitigation is shown in Table 2.1 in the 'Summary' subsection below.

BIOTA

The use of DDACarbonate showed an acceptable risk to predators from secondary poisoning for all scenarios except the bridge.

SUMMARY

Table 2.1 summarises the long-term (T2) risks predicted once risk mitigation is taken into account.

The long-term risk from the proposed use of DDACarbonate as a wood preservative is acceptable for use classes 1 and 2 from an environmental perspective providing suitable risk mitigation is applied (i.e. application processes must be carried out within a contained area, situated on impermeable hard standing, with bunding to prevent run-off and a recovery system in place; the storage of freshly treated wood must be either, undercover with a recovery system in place or on impermeable hard standing and bunded to prevent run-off with a recovery system in place).

The long term risk from the proposed use of DDACarbonate as a wood preservative for use class 3 when applied as a vacuum pressure treatment is acceptable from an environmental perspective i.e. only T2 is acceptable providing suitable risk mitigation is applied (see above). However short term effects on sediment dwelling invertebrates cannot be excluded from this use (this is in line with how other PT8 substances have been assessed).

The risk from the proposed use of DDACarbonate as a wood preservative for use class 3 when applied as a dipping treatment has not been found to be acceptable due to risk to sediment dwelling organisms. Further information would be required at product authorisation before these uses could be authorised.

The risk from the proposed use of DDACarbonate as a wood preservative for use class 4a is acceptable from an environmental perspective providing suitable risk mitigation is applied (see above).

The risk from the proposed use of DDACarbonate as a wood preservative for use class 4b has not been found to be acceptable due to risk to sediment dwelling organisms. Further information would be required at product authorisation before these uses could be authorised.

Table 2.1 Summary of the long-term (T2) risks predicted for the use of water-based products containing DDACarbonate once risk mitigation is take into account

Process / Article	Method	Use Class	Aquatic Compartment			Soil Compartment
			STP	Surface water	Sediment	
Application	Vacuum Pressure	2	√	√	√	√
	Dipping		√	√	√	√
	Vacuum Pressure	3	√	√	√	√
	Dipping		√	√	√	√
	Vacuum Pressure	4	√	√	√	√
Noise barrier	Vacuum Pressure	3	√	√	√x	√
	Dipping		√	√	X	√x
Bridge	Vacuum Pressure	3	-	NR	NR	-
	Dipping		-	NR	NR	-
Jetty	Vacuum Pressure	4b	-	√	X	-
Piling	Vacuum Pressure	4b	-	√x	X	-
Harbour	Vacuum Pressure	4b	-	√	X	-
Fence	Vacuum pressure	3	-	-	-	√
	Dipping		-	-	-	X
House	Vacuum pressure	3	-	-	-	√
	Dipping		-	-	-	X
Transmission pole	Vacuum pressure	4a	-	-	-	√
Fence post	Vacuum pressure	4a	-	-	-	√

√ = PASS (provided suitable mitigation provided).

√x = PASS at T2, fail at T1

NR = scenario considered not relevant

- = Not applicable

= further risk mitigation /restriction required

X = fail

2.2.3. List of Endpoints

In order to facilitate the work of Member States in granting or reviewing authorisations, and to apply adequately the provisions of Article 5(1) of Directive 98/8/EC and the common principles laid down in Annex VI of that Directive, the most important endpoints, as identified during the evaluation process, are listed in Appendix I.

3. DECISION

3.1. Background to the Decision

The human health risk assessment indicates that the risks for the professional/industrial users of the biocidal product for the exposure scenarios are acceptable as long as specified procedures are followed. Principles of good working practice should be applied and product label instructions and recommendations respected. The risks to human health following secondary exposure are also considered acceptable.

The environmental risk assessment indicates that DDACarbonate would not pose an unacceptable threat to STP microorganisms.

The industrial use and storage of wood treated with DDACarbonate products at industrial treatment sites for dipping and vacuum treatment could result in an unacceptable risk to surface waters. In addition, an unacceptable risk to the sediment compartment has been predicted for DDACarbonate for all industrial processes tested and the use of DDACarbonate in all industrial scenarios has been shown to present an unacceptable risk to the soil compartment after long-term use. Effluents to the STP should not be allowed and therefore losses to an STP should be prevented by the measures outlined below. All collected contaminated waste should be treated by an appropriate method (e.g. incineration). The UK CA proposes that to prevent losses of treatment solution DDACarbonate products should only be permitted for industrial use at industrial wood treatment sites that can comply with the requirements in the following list. The UK CA considers that these measures are a reasonable requirement for all industrial wood treatment sites to prevent unnecessary contamination of the environment and is common to best available practice (BAP) throughout much of the existing industry in the UK.

1. For the aquatic environment (industrial use):
   - Application processes must be carried out within a contained area;
     - situated on impermeable hard standing,
     - with bunding to prevent run-off and
     - a recovery system in place (e.g. sump).
   - Storage of treated wood must be either;
     - undercover with a recovery system in place (e.g. sump) or
     - on impermeable hard standing and bunded to prevent run-off with a recovery system in place (e.g. sump).

2. For the terrestrial environment (industrial use):
   - Storage of treated wood must be either;
     - undercover with a recovery system in place (e.g. sump) or
     - on impermeable hard standing and bunded to prevent run-off with a recovery system in place (e.g. sump).

For in service use in the aquatic environment; in the bridge over a pond scenario all of the assessments predicted an unacceptable risk to the water compartment following in-service leaching. The same pattern of risk was reflected for the sediment compartment, with all the predictions carried out indicating that there could be an unacceptable risk. However the UK CA considered that the bridge scenario is not representative of a common use pattern for wood preservatives and therefore not relevant for the purposes of this assessment.

For the noise barrier scenario, long-term aquatic exposure (excluding sediment) to DDACarbonate from timber dipping or vacuum treatment is acceptable. In addition the noise barrier displayed a long-term aquatic exposure of sediment to DDACarbonate from timber pre-treated by vacuum which was acceptable. However, the risk to sediment was not acceptable following dipping treatment.

An acceptable risk to surface waters was found for the jetty, piling and harbour scenarios for freshwater uses for surface water, but the risk was not acceptable for sediment for any of these uses. The UK CA does not consider there is sufficient information to recommend these uses and there is no mitigation available that would be sufficient to give an acceptable risk.

Overall, no risk mitigation for end-use of timber products with respect to the aquatic environment is considered necessary for use class 3 (vacuum treated) but further risk mitigation is required for use class 3 (dipping) and use class 4 where an acceptable risk to sediment has not been demonstrated.

The UK CA considers that further restrictions for end-use of pre-treated timber are not practical beyond those already associated with the hazard classification scheme for treated wood (HC 1-4) and no further restrictions are recommended. However, the in service use of these products by amateurs and professionals can be controlled through labelling. Therefore, the UK CA recommends that the use of DDACarbonate wood preservative products should be restricted to prevent use on wooden structures over water and/or where direct losses and leaching to water from freshly treated timber may occur.

In addition the UK CA considers that a further wood leaching study is required to produce more accurate PEC values. Such a study should address the lack of direct information for timber treated by the dipping method. The UK CA also considers that the study should be conducted for a longer time period than that already available for both vacuum impregnation and dipping treatments in order to refine the risk assessment for TIME 2 assessments. The UK CA further considers that such a study could be used by member states to calculate more appropriate PEC values at product registration.

In soil the in service risk was acceptable for vacuum treated uses (use class 3 & 4), but has not been shown to be acceptable for the dipping treatments (use class 3). The UK CA considers that the provision of a further leaching study specifically on the dipping treatment described above would also be helpful in producing more accurate soil PECs which may allow an acceptable risk to be displayed.

The risk assessment only considered the use of wood in service that had been industrially vacuum- or dip- treated. No consideration of application of the product *in-situ* was made. Should such a use be requested in future appropriate consideration of it will be required.

Overall conclusions on environmental risk:

Aquatic compartment

1) ***STP –*** *no risk to STP.*

2) ***Surface water***

   a) *Industrial processes – acceptable risk for UC 2 & 3 when applied as vacuum treatment. Not acceptable for UC 2 & 3 following dipping or UC 4 following vacuum treatment – therefore mitigation measures proposed.*

   b) *In service leaching – 'bridge over pond' scenario unacceptable risk for UC 3 dipping and vacuum treatment but scenario not considered ecologically relevant, because of the assumed small size of the water body. Noise barrier scenario acceptable risk for UC 3 following dipping and vacuum treatment. Acceptable risk for jetty, piling and harbour scenarios (UC 4) following vacuum treatment.*

3) Sediment

a) Industrial processes – unacceptable risks for all uses therefore mitigation measures proposed.

b) In service leaching – noise barrier scenario acceptable long term (T2) risk for UC3 following vacuum treatment, but dipping not acceptable. Unacceptable risk for jetty, piling and harbour scenarios (UC 4) following vacuum treatment.

Terrestrial Compartment

1) Risks to soil

a) ***Industrial processes –*** *unacceptable risk for all industrial scenarios therefore risk mitigation measures proposed.*

b) ***In service leaching –*** *acceptable risk UC 3 & 4 following vacuum treatment. Unacceptable risk for UC 3 following dipping for all scenarios.*

The physico-chemical properties of the active substance and associated biocidal product have been evaluated and are deemed acceptable for their appropriate use, storage and transportation.

The assessment of the biocidal activity of DDACarbonate demonstrates that it has a sufficient level of efficacy against the target organism(s) and the evaluation of the summary data provided in support of the efficacy of the accompanying product, establishes that the product may be expected to be efficacious.

3.2. Decision Regarding Inclusion in Annex I

The active substance DDACarbonate shall be included in Annex I to Directive 98/8/EC as an active substance for use in product–type **8** (wood preservative), subject to the following specific provisions:

- The active substance DDACarbonate, as manufactured, shall have a minimum purity of 740 g/kg (dry weight).

- In view of the potential risks identified for human health, products containing DDACarbonate must be used with suitable engineering measures and/or appropriate personal protective equipment, unless it can be demonstrated in the application for product authorisation that risks to operators can be reduced to an acceptable level by other means.

- In view of the potential risks to the aquatic and terrestrial environments, appropriate risk mitigation measures must be taken. In particular, labels and/or safety data sheets of products authorised for professional use shall indicate that freshly treated timber must be stored after treatment under shelter or on impermeable hard standing to prevent direct losses to soil or water and that any losses must be collected for reuse or disposal. Similarly industrial application should be conducted within a contained area or on impermeable hard standing with bunding.

- In view of the unacceptable risks to the aquatic or terrestrial environment identified in the case of wood treated by dipping with DDACarbonate for UC 3 and for in-service use of treated wood in the 'bridge over a pond' scenario in UC 3[3] and in contact with fresh water (UC 4b), it is appropriate to require that products are not authorised for the treatment of wood intended for those uses, unless data are submitted demonstrating that the product will meet the requirement of both Article 5 of Annex VI to Directive 98/8/EC, if necessary by the application of appropriate risk mitigation measures.

3.3. Elements to be Taken Into Account by Member States When Authorising Products

In the case of products classified as Corrosive (C; R34), all appropriate risk mitigation measures should be taken to prevent exposure by any route. For the applications considered in this assessment, the inhalation route is of lower concern, relative to the dermal route, because the product is not to be manually sprayed and the active substance has a vapour pressure of 7.7×10^{-3} Pa at 25 °C. In fact, the exposure assessment identified limited or negligible inhalation exposures. However, it was not possible to perform a quantitative risk assessment for this route because no toxicity data are available to determine an inhalation AEC. As a result, suitable engineering measures and/or respiratory protective equipment is recommended for all scenarios except automated dipping and handling of treated wet wood as in these circumstances inhalation exposure is predicted to be zero.

The quantitative dermal local effects risk assessment for professionals indicates a risk of local effects on the skin, even at Tier II. However, these risks result from a simple comparison of the dermal AEC to the in-use concentrations of DDACarbonate without taking into account the protection provided by the Tier II control measures.

N.B. Quantitative risk assessments for local effects remain under discussion at technical level. Overall, therefore despite the apparent risks identified for all scenarios, the actual likelihood of exposure together with a number of other factors, have been taken into account to justify Annex I inclusion. These considerations are outlined in Section 2.2.1.4.1 and must be taken into account at product authorisation. The risk mitigation measures proposed to minimise dermal exposure will include suitable engineering measures and/or appropriate and adequate PPE (e.g. chemically and mechanically resistant gloves and boots, goggles/faceshield, chemically resistant coveralls or aprons), frequently changed gloves, provision of clean coveralls, possibly changed daily, and if necessary, the use of gauntlet gloves (with coveralls sleeves over). To ensure the controls in the workplace are adequate, it is also proposed that a skin surveillance and care scheme is established in workplaces where DDACarbonate products are used.

In the case of products classified as Corrosive (C; R34), the PPE for emergency responders is gloves, protective clothing and respiratory protection.

3 This scenario is being revised at the level of OECD to become more ecologically relevant by increasing the pond size.

With regard to the environment, the need to address any specific national conditions and/or undertake regional assessments should be considered, as only local environmental risk assessments have been carried out in this evaluation. In particular, an assessment of the risk posed to bats has not been carried out as part of this review but has been deferred to the product authorisation stage, where specific Member States' concerns should be addressed.

The efficacy/label claims of DDACarbonate-containing products must be demonstrated at the product authorisation stage. Basic efficacy against wood rotting fungi has been demonstrated for softwood. Suitable data in support of use on hardwood and against sapstain, blue stain and mould fungi will have to be provided at product authorisation stage. Where use class 4 is included in a product claim, suitable data in support of use against white rot and soft rot fungi will have to be provided at the product authorisation stage. Basic efficacy against wood destroying insects has been demonstrated for softwood. Suitable data in support of use on hardwood and in support of the requested application rates for dipping will have to be provided at the product authorisation stage. Where a general claim is made for use against wood destroying insects, suitable data in support of use against termites will have to be provided at the product authorisation stage.

3.4. Requirement for Further Information

Additional validation data are required for some of the impurities in the technical concentrate.

A confirmatory method of analysis for monitoring residues in soil must be provided, at the latest 6 months before the date of inclusion.

Due to the high degree of sorption exhibited by DDACarbonate, its DT_{50} in soil may be longer than the 30 d value used in the risk assessment which was based upon the ready biodegradation study. In order to clarify the DT_{50} value in soil further information may be required by Member States at the product authorisation stage.

The UK CA considers that the provision of a further leaching study specifically on the dipping treatment would also be helpful in producing more accurate soil PECs which may allow an acceptable risk to be displayed.

Further information to verify the CMC (critical micelle concentration) may be required by Member States.

Notwithstanding the above, it is considered that the evaluation has shown that sufficient data have been provided to verify the outcome and conclusions, and permit the proposal for the inclusion of DDACarbonate in Annex I to Directive 98/8/EC.

3.5. Updating this Assessment Report

This assessment report may need to be updated periodically in order to take account of scientific developments and results from the examination of any of the information referred to in Articles 7, 10.4 and 14 of Directive 98/8/EC. Such adaptations will be examined and

finalised in connection with any amendment of the conditions for the inclusion of DDACarbonate in Annex I to the Directive.

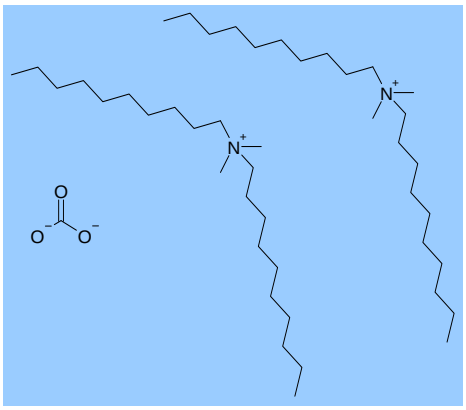
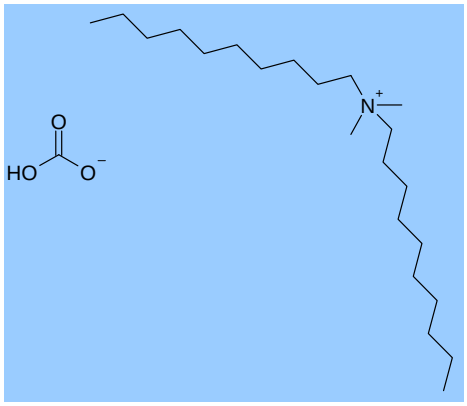
Appendix I: List of endpoints

Chapter 1: Identity, Physical and Chemical Properties, Classification and Labelling

Active substance (ISO Common Name)	Didecyldimethylammonium Carbonate / Bicarbonate (DDACarbonate)
Product-type	PT 8 Wood Preservative

Identity

Chemical name (IUPAC)	Reaction mass of: N,N-Didecyl-N,N-dimethylammonium Carbonate; and N,N-Didecyl-N,N-dimethylammonium Bicarbonate
Chemical name (CA)	1-Decanaminium, N-decyl-N,N-dimethyl-, carbonate (3:2). A mixture of 1-Decanaminium, N,decyl-N,N-dimethyl-, carbonate and 1-Decanaminium, N,decyl-N,N-dimethyl-, bicarbonate
CAS No	894406-76-9 (mixture) 148788-55-0 (carbonate) 148812-65-1 (bicarbonate)
EC No	451-900-9
Other substance No.	None
Minimum purity of the active substance as manufactured (g/kg or g/l)	Minimum: 740 g/kg On a dry weight basis the theoretical min purity of the active is 740 g/kg. The active substance is manufactured as min. 450 g/kg aqueous solution. As it was not possible to isolate DDACarbonate as a technically pure solid, a concentrated form (with as much process solvent as possible removed) was prepared for the testing of the physico-chemical properties. The purity was 79.7 %. A technical material (active substance in process solvent) was also used for testing. This contained approximately 50 % w/w of the active with 30 – 40 % w/w water which is the substance as manufactured
Identity of relevant impurities and additives (substances of concern) in the active substance as manufactured (g/kg)	Methanol: < 3 %
Molecular formula	Didecyldimethylammonium Carbonate: C_{45} H_{96} N_2 O_3

	Didecyldimethylammonium Bicarbonate: C_{23} H_{49} N O_3
Molecular mass	Didecyldimethylammonium Carbonate: 713.3 Didecyldimethylammonium Bicarbonate: 387.6
Structural formula	**Didecyldimethylammonium Carbonate**  **Didecyldimethylammonium Bicarbonate:** 

Physical and chemical properties

Melting point (state purity)	Change in viscosity at 59 – 81 °C (79.7 % purity) UK: The physicochemical tests conducted on this gel were originally conducted when the substance was notified under Directive 92/32/EEC (Notification number 05-05-0518). The applicant states that there was a DSC response was very poor because of the wide range of melting and so the modified liquid bath method was used. The modification of the method involved placing the test material in a test tube using a syringe to a height of approximately 10 mm and using wire to fasten the test tube to the thermometer. The DSC trace submitted for boiling point determination gave a trace from 25 - 400 °C but showed no exotherm that could be attributed to melting. The effect seen in the melting point test could be a change in viscosity wrongly interpreted as melting.
Boiling point (state purity)	107.8 - 244.4 °C at 102 to 104 kPa (79.7 % purity) It is not possible to isolate DDACarbonate as a technically pure solid so a concentrated form (with as much process solvent as possible removed) was prepared for the testing of the physico-chemical properties. The purity was 79.7 %. The DSC analysis which showed a trace from 25 - 400 °C. Three exotherms were recorded; two were smaller and less sharp at ~ 140° and 170 °C. The third was sharp at ~185 °C. We would agree that as the testing was conducted on a mixture this endpoint is of little value.
Temperature of decomposition	Decomposition not noted
Appearance (state purity)	Yellow solid (gel) (79.7 % purity)
Relative density (state purity)	0.947 at 21.2 ± 0.5 °C (79.7 % purity)
Surface tension	31.1 mN/m at 21.4 ± 0.5 °C (1.06 g/L aqueous solution)
Vapour pressure (in Pa, state temperature)	4.6×10^{-3} Pa at 20 °C 7.7×10^{-3} Pa at 25 °C 7.7×10^{-3} Pa at 25 °C The sample used prepared for the testing was a concentrated form which contained a significant amount of residual volatile material.
Henry's law constant (Pa m^3 mol^{-1})	1.78×10^{-6}
Solubility in water (g/l or mg/l, state temperature)	Miscible in all proportions with water at 20.0 ± 0.5 °C up to ~ 796 g/l

Solubility in organic solvents (in g/l or mg/l, state temperature)	The solubility of DDACarbonate in methanol and octanol is approximately 900 g/l. The effect of temperature (10 and 30 ± 0.5 °C) was determined to have no effect on solubility.
Stability in organic solvents used in biocidal products including relevant breakdown products	DDACarbonate, in wood preservative applications, will not be supplied in organic solvents. Thus, it is considered that stability in organic solvents used in biocidal products is not required.
Partition coefficient (log P_{OW}) (state temperature)	Log Kow = 0.053 Ratio of solubilities in octanol and water is 1.13. Directive 92/69/EEC states that the HPLC method is not applicable to strong acids and bases, metal complexes, surface-active materials or substances which react with the eluent.
Hydrolytic stability (DT_{50}) (state pH and temperature)	pH 5 = 368 days at 25 °C (read across data from DDAC) pH 7 = 175 days at 25 °C (read across data from DDAC) pH 9 = 506 days at 25 °C (read across data from DDAC)
Dissociation constant	DDACarbonate is a polar quaternary alkyl ammonium compound and as such, it is already a fully dissociated molecule which is ionised at all times. As can be seen from the water solubility test the solubility (and hence extent of ionisation) is unaffected by pH. Therefore, no dissociation constant values can be determined.
UV/VIS absorption (max.) (if absorption > 290 nm state ε at wavelength)	pH 2.0, λ_{max} 233 nm, ε 29.7 $dm^3mol^{-1}cm^{-1}$; pH 11.8 λ_{max} 211 nm, ε 118 $dm^3mol^{-1}cm^{-1}$ There is no absorption > 290 nm.
Photostability (DT_{50}) (aqueous, sunlight, state pH)	> 30 days at 25 °C and pH 7 (read across data from DDAC)
Quantum yield of direct phototransformation in water at Σ > 290 nm	Negligible, as substance is photolytically stable
Flammability	Not highly flammable
Explosive properties	No explosive properties
Oxidising properties	No oxidising properties
Auto-flammability	346 ± 5 °C 92/69/EEC Method A15
Flash point	No flash point observed up to 100 °C. The technical concentrate is not flammable.

Note: It was not possible to isolate the technically pure solid. The maximum concentration possible was an approximately 80 % mixture with residual water and propylene glycol. This mixture was specially prepared for testing the physicochemical properties.

Classification and proposed labelling

with regard to physical/chemical data	Not classified
with regard to toxicological data	**DDACarbonate (100 % a.s.)** **C; R34: Causes burns.** (CLP classification: Skin Corr. 1B; H314) **Xn; R21: Harmful in contact with skin.** (CLP classification: Acute Tox. 3; H311) **Xn; R22: Harmful if swallowed.** (CLP classification: Acute Tox. 3; H301) **DDACarbonate (50 % a.s.)** **C; R34: Causes burns.** (CLP classification: Skin Corr. 1B; H314) **Xn; R21: Harmful in contact with skin.** (CLP classification: Acute Tox. 4; H312) **Xn; R22: Harmful if swallowed.** (CLP classification: Acute Tox. 4; H302)
with regard to environmental data	**N; R50: Very toxic to aquatic organisms**

Chapter 2: Methods of Analysis

Analytical methods for the active substance

Technical active substance (principle of method)	HPLC-ELSD
Impurities in technical active substance (principle of method)	HPLC-ELSD GC-FID Titration These methods are not all fully validated. Additional validation data must be provided.

Analytical methods for residues

Soil (principle of method and LOQ)	LC-MS LOQ 0.01 mg/kg The method submitted for analysis of the similar substance DDAC is considered suitable for DDACarbonate. A confirmatory method for residues in soil is required.
Air (principle of method and LOQ)	Not required
Water (principle of method and LOQ)	LC-MS/MS LOQ 0.1 µg/L Validated for two ion transitions: primary transition (m/z 326→186) and a confirmatory transition (m/z 326→57) (Fully validated in drinking and surface water)
Body fluids and tissues (principle of method and LOQ)	Not required
Food/feed of plant origin (principle of method and LOQ for methods for monitoring purposes)	Not required
Food/feed of animal origin (principle of method and LOQ for methods for monitoring purposes)	Not required

Chapter 3: Impact on Human Health

The Applicant has notified Technical Grade Didecyldimethylammonium carbonate/bicarbonate (DDACarbonate) with a purity of 50 % (50 % active ingredient (a.s.)) for Annex I inclusion. The acute toxicity studies, a skin irritation study, and a repeated dermal exposure study were performed using technical grade DDACarbonate (50 % a.s.). However the doses administered to animals in the acute oral study and the repeated dermal study were adjusted to take account of DDACarbonate purity and therefore represent 100 % active ingredient. A concentrated form of technical DDACarbonate (80 % a.s.) was used in the genotoxicity studies. No data are available to assess the toxicokinetic profile, skin sensitisation, sub-chronic and chronic toxicity, carcinogenicity and reprotoxicity potential of DDACarbonate. However data from studies conducted on a structurally related substance, Didecyldimethylammonium Chloride (DDAC) with a technical grade purity of 80 % (unless otherwise stated) are available. The doses of DDAC administered in the majority of these studies were adjusted to take account of purity and in such cases doses are presented as 100 % a.s.

Absorption, distribution, metabolism and excretion in mammals

Rate and extent of oral absorption:	An oral absorption value of 40 % is proposed based on DDAC data.
Rate and extent of dermal absorption:	Based on a study of DDAC, a dermal absorption value of 25 % is proposed for formulations containing ≤ 1.85 % DDACarbonate (i.e. the concentration tested) and a dermal absorption value of 100 % is proposed for formulations containing > 1.85 % DDACarbonate due to the corrosive nature of DDACarbonate.
Distribution:	Once absorbed, ^{14}C-DDAC and therefore DDACarbonate is distributed reasonably widely throughout the body and is therefore likely to reach the bone marrow and could also cross the placenta. Exposure via breast milk is unlikely given the non-lipophilic nature of DDAC and DDACarbonate.
Potential for accumulation:	Levels of radioactivity remaining in the carcass and several major organs following single and repeated administration of DDAC were similar. This suggests that DDAC/DDACarbonate is unlikely to bio-accumulate on repeated dosing.
Rate and extent of excretion:	Elimination after single or repeated oral administration occurs mainly in the faeces and is largely complete 72 hours after dosing. On day 7 post-exposure at least 91 % of the radioactivity had been excreted by animals exposed to a single dose (5 or 50 mg/kg bw DDAC) or repeatedly exposed to 3.4 mg/kg bw/day DDAC for 14 days. A similar elimination profile is predicted for DDACarbonate.
Toxicologically significant metabolite(s)	None.

Acute toxicity

Rat LD_{50} oral	245 mg/kg DDACarbonate (100 % a.s.)
Rat LD_{50} dermal	< 2000 mg/kg DDACarbonate (50 % a.s.) ≡ < 1000 mg/kg DDACarbonate (100 % a.s.) Animals killed *in extremis* day one post-exposure due to dermal corrosion.
Rat LC_{50} inhalation	No data are available.
Skin irritation	DDACarbonate (50 % a.s.) is corrosive.
Eye irritation	The eye irritation potential of DDACarbonate has not been tested but a study is not necessary as DDACarbonate was identified as corrosive in dermal studies.
Skin sensitization (test method used and result)	Buehler - Not sensitizing (DDAC 80 % a.s.). Buehler - Not sensitizing (DDAC 80 % a.s.). Non-standard photo-allergy – Not sensitising (DDACarbonate 100 % a.s.).

Repeated dose toxicity

Species/ target / critical effect	The results of the repeated dose toxicity studies, performed in rats, mice and dogs, reveal a pattern of response which is consistent with the mode of action of a corrosive substance. The observed systemic effects are considered to be secondary to local irritant/corrosive effects.
Lowest relevant oral NOAEL / LOAEL	NOAEL < 3 mg/kg DDAC (100 % a.s.) from 52-week dog study. LOAEL 3 mg/kg DDAC (100 % a.s.) from 52-week dog study.
Lowest relevant dermal NOAEL / LOAEL	NOAEC < 10 µg/cm^2 DDACarbonate from 3-week rat study. LOAEC 10 µg/cm^2 DDACarbonate from 3-week rat study.
Lowest relevant inhalation NOAEL / LOAEL	No data are available.

Genotoxicity	DDACarbonate (80 % a.s.) did not induce gene mutations in bacterial or mammalian cells or induce chromosome aberrations in human lymphocytes *in vitro*.

Carcinogenicity

Species/type of tumour	DDAC (100 % a.s.) was not found to be carcinogenic in rats and mice. On the basis of these data, DDACarbonate is not predicted to be a carcinogen.
lowest dose with tumours	N/A

Reproductive toxicity

Species / Reproduction target / critical effect	DDAC did not have any effects on fertility or reproductive performance in the F0 or F1 generations when administered at the highest doses of 79-149 mg/kg bw/day (100 % a.s.) in males and 99-154 mg/kg bw/day (100 % a.s.) in females. On the basis of these data, DDACarbonate is not predicted to cause adverse effects on fertility or reproductive performance.
Lowest relevant reproductive NOAEL / LOAEL	Reproductive NOAEL: 79 mg/kg DDAC (100 % a.s.) – highest dose tested. Non- reproductive NOAEL: 38 mg/kg DDAC (100 % a.s.) based on reduced body weights in animals of all generations. These effects are considered to be a consequence of local irritation/corrosion and therefore this NOAEL and the LOAEL of 79 mg/kg DDAC (100 % a.s.) for both adults and pups are for the underlying local toxicity.
Species / Developmental target / critical effect	No developmental toxicity was observed in the rat exposed to DDAC (100 % a.s.) up to maternally toxic dose levels. However, developmental toxicity was observed in rabbits following exposure to DDAC (100 % a.s.). The increased incidence of dead foetuses per litter and the reduction in foetal body weight occurred only in the presence of significant maternal toxicity. The absence of developmental toxicity following exposure to a lower dose of DDAC which resulted in less severe maternal toxicity suggests that the developmental effects observed in this study were non-specific and occurred as a consequence of maternal toxicity. On the basis of these data, DDACarbonate is not predicted to cause developmental toxicity.
Developmental toxicity	
Lowest relevant developmental NOAEL / LOAEL	Maternal NOAELs of 1 mg/kg bw/day DDAC (100 % a.s.) were identified in the rat and rabbit studies plus LOAELS of 10 and 3 mg/kg bw/day respectively. The observed adverse effects are considered to be either the direct result of or a consequence of local irritation/corrosion and therefore the maternal NOAELs and LOAELs are for the underlying local toxicity. A developmental toxicity NOAEL of 3 mg/kg bw/day (100 % a.s.) was also identified from the rabbit study but the developmental effects are considered secondary to maternal toxicity.

Neurotoxicity / Delayed neurotoxicity

Species / target / critical effect	No clinical signs or changes considered to be indicative of neurotoxicity were observed in the acute studies on DDACarbonate or during the repeated dose toxicity studies for the read across substance DDAC. DDACarbonate is not considered to be neurotoxic.
Lowest relevant developmental NOAEL / LOAEL.	N/A

Other toxicological studies

.....	N/A

Medical data

.....	No data are available in relation to human exposure to DDACarbonate. All reported cases of DDAC exposure demonstrate the irritant potential of DDAC.

Summary	Value	Study	Safety factor
Oral AEC (acute, medium & chronic)	0.06 mg/ml (0.3 mg/kg bw/day)	Rat developmental study	3.2
Dermal AEC (acute, medium & chronic)	1.6 µg/cm^2/day (0.02 %)	Rat 3-week study	6.4
Inhalation AEC (acute, medium & chronic)	No data are available.		

Acceptable exposure scenarios (including method of calculation)

Professional users

Exposure route: Dermal and inhalation

For the applications considered in this assessment, the inhalation route is of lower concern, relative to the dermal route, because the product is not to be manually sprayed and the active substance has a vapour pressure 7.7 x 10^{-3} Pa at 25 °C. In fact, the exposure assessment identified limited or negligible inhalation exposures. However, it was not possible to perform a quantitative risk assessment for this route because no toxicity data are available to determine an inhalation AEC. As a result, suitable engineering measures and/or respiratory protective equipment is recommended for all scenarios except automated dipping and handling of treated wet wood as in these circumstances inhalation exposure is predicted to be zero.

The quantitative dermal local effects risk assessment for professionals indicates a risk of local effects on the skin for all scenarios, even at Tier II. However, these risks result from a simple comparison of the dermal AEC to the in-use concentrations of DDACarbonate without taking into account the protection provided by the Tier II control measures. N.B. Quantitative risk assessments for local effects remain under discussion at technical level. Overall, therefore despite the apparent risks identified for all scenarios, the actual likelihood of exposure together with a number of other factors, have been taken into account to justify Annex I inclusion. These considerations are outlined in Section 2.2.1.4.1 and must be taken into account at product authorisation. The risk mitigation measures proposed to minimise dermal exposure will include suitable engineering measures and/or appropriate and adequate PPE (e.g. chemically and mechanically resistant gloves and boots, goggles/faceshield, chemically

resistant coveralls or aprons), frequently changed gloves, provision of clean coveralls, possibly changed daily, and if necessary the use of gauntlet gloves (with coveralls sleeves over). To ensure the controls in the workplace are adequate, it is also proposed that a skin surveillance and care scheme is established in workplaces where DDACarbonate products are used.

Non-professional users

Not applicable. The product is not intended for use by non-professionals.

Secondary exposure

Exposure route: Inhalation, dermal and oral

Oral AEC: 0.06 mg/l; Dermal AEC: 1.6 µg/cm^2

Secondary exposure scenario		**Concentration of DDACarbonate**	**Acceptable risk?**
Acute exposure scenarios	Adult non professional sanding treated wood (inhalation)	0.026 mg/m^3 2.6 x 10^{-8} mg/ml	See text below
	Adult non professional sanding treated wood (dermal)	0.82 µg/cm^2	Yes
	Infant mouthing treated wood (oral ingestion)	Vacuum pressure impregnated wood: 0.0207 mg/ml stimulated saliva	Yes
	Adult cleaning clothes	3.54 µg/cm^2	No - See text below
	Inhalation of volatilised residues indoors (inhalation)	2.2 mg/m^3 Maximum possible exposure at 25 °C	Yes
Chronic exposure scenarios	Adult professional sanding treated wood (inhalation)	0.026 mg/m^3	See text below
	Adult professional sanding treated wood (dermal)	0.82 µg/cm^2	Yes
	Infants playing (dermal)	0.001 mg on exposed skin 0.005 µg/cm^2	Yes
	Infants playing (oral)	0.00093 mg/ml saliva via oral route	Yes
	Inhalation of volatilised residues indoors (inhalation)	2.2 mg/m^3 Maximum possible exposure at 25 °C	Yes

Acute exposure scenarios

a) **Adult non-professional sanding treated wood** (inhalation). Exposure to DDACarbonate by this route will be via inhalation of wood dust particles. In the absence of appropriate data from which to derive an inhalation AEC, it is proposed to compare inhalation exposure to the oral AEC. Although route-to-route extrapolation for local effects should normally be avoided due to uncertainties related to the difference of site of contact sensitivity, it is considered that these concerns are alleviated by the considerable margin of safety of 90×10^{6} between the exposure estimate of 2.2×10^{-9} mg/ml and the NOAEC of 0.2 mg/ml (oral AEC being 0.06 mg/ml). Therefore exposure via this route is considered to be an acceptable risk.

b) **Adult non-professional sanding treated wood** (dermal exposure). Dermal exposure to DDACarbonate is predicted to be to a concentration 0.82 µg/cm^2. This is below the dermal AEC value of 1.6 µg/cm^2 and therefore, the risk of exposure to DDACarbonate in this scenario is considered to be acceptable.

c) **Infants mouthing treated wood off-cut** (oral exposure). For an infant mouthing vacuum pressure treated wood, the calculated oral concentration is below the oral AEC value of 0.06 mg a.s./ml therefore the risk is acceptable.

d) **Adult cleaning work clothes at home** (dermal exposure). The predicted exposure concentration, which is based on worst case assumptions, in this scenario is greater than the dermal AEC and so suggests that the risk is unacceptable. In reality, at large scale dipping operations all laundry will be professionally cleaned therefore, the UK CA consider that measures will be in place to ensure that exposures will be prevented and so, this is not considered to represent an unacceptable risk. Exposure may occur to those workers involved in smaller scale dipping operations. However, the predicted exposure concentration is very much a worst case estimate and the dermal AEC is based on only very slight irritation.

e) **Inhalation of volatilised residues indoors** (inhalation exposure). The product is to be used to pre-treat outdoor timbers. The product is also to be used to pre-treat structural timbers for interior use (e.g. in roofs) and on window frames and internal/external doors; the latter often being painted/stained shortly before or after installation. DDACarbonate is of low volatility and the worst-case assessment for inhalation of residues volatilised indoors from treated timbers shows risks will be insignificant.

Chronic exposure scenarios

a) Adult – professional sanding treated wood (inhalation exposure). It is assumed that a professional sanding will wear a suitable mask and therefore, no significant exposure will occur. However in the absence of RPE exposure to DDACarbonate by this route will be via inhalation of wood dust particles. In the absence of appropriate data from which to derive an inhalation AEC, we propose to compare inhalation exposure to the oral AEC. Although route-to-route extrapolation for local effects should normally be avoided due to uncertainties related to the difference of site of contact sensitivity, it is considered that these concerns are alleviated by the considerable margin of safety of 90×10^{6} between the exposure estimate of 2.2×10^{-9} mg/ml and the NOAEC of 0.2 mg/ml (oral AEC being 0.06 mg/ml). Therefore exposure via this route is considered to be an acceptable risk.

b) **Adult – professional sanding treated wood** (dermal exposure). Dermal exposure to DDACarbonate is predicted to be to a concentration 0.82 µg/cm^2. This is below the dermal AEC value of 1.6 µg/cm^2 and therefore, the risk from exposure to DDACarbonate in this scenario is considered to be acceptable.

c) **Infants playing on (weathered) playground structure and mouthing treated wood** (dermal exposure). Even for a worst case scenario the predicted dermal exposure concentration is below the dermal AEC therefore it is considered that this represents an acceptable risk in this scenario.

d) **Infants playing on (weathered) playground structure and mouthing treated wood** (oral exposure). The predicted exposure is well below the AEC value applied to DDACarbonate in saliva. The risk from exposure to DDACarbonate in this scenario is considered acceptable.

e) **Inhalation of volatilised residues indoors** (inhalation route). As for the acute secondary exposure scenario for inhalation of residues volatilised indoors from treated timbers, risks from chronic exposure will be similarly insignificant.

Combined exposure

With systemic exposure it is usually appropriate to add together exposures via the different routes (oral/dermal/inhalation) to determine a 'combined exposure'. This is not appropriate for assessment of local effects (irritancy) where risk is determined by its acceptability via each individual route separately.

Chapter 4: Fate and Behaviour in the Environment

Route and rate of degradation in water

Hydrolysis of active substance and relevant metabolites (DT_{50}) (state pH and temperature)†	pH 5: 368 d* at 25 ^{o}C
	pH 7 (HEPES buffer): 175 d* at 25 ^{o}C
	pH 7 (TRIS buffer): 194 d* at 25 ^{o}C
	pH 9: 506 d* at 25 ^{o}C
Photolytic / photo-oxidative degradation of active substance and resulting relevant metabolites†	Aqueous buffer solution (pH 7), 25 ^{o}C, xenon arc lamp with emissions 290 nm – 750 nm; reported as one half the intensity of the sun; 30 d incubation. DIRECT PHOTODEGRADATION: Stable INDIRECT PHOTODEGRADATION (in presence of acetone): K (light) = 0.00304 d^{-1} K (dark) = 0.00160 d^{-1} K (photolysis only) = 0.00144 d^{-1} DT50 (photolysis only) = 481 d
Readily biodegradable (yes/no)	Yes
Biodegradation in seawater	No data provided and not required for requested uses.‡
Distribution in water / sediment systems (active substance)†	The study was considered acceptable as supporting information only. Two water/sediment systems were tested. The substance rapidly migrates from the aqueous phase to the sediment phase (water phase $DissT_{50} \leq 0.05$ d and $DissT_{90} \leq 6.7$ d under conditions of the test). The degradation in the sediment phase did not increase very much after the first month and the DT_{50} of the total system was not reached within the 120 days test duration
Distribution in water / sediment systems (metabolites)†	No metabolites were observed.

* An accurate estimate of half-lives could not be made since no significant degradation occurred during the 30-day test.
† study conducted with DDAC
‡Information has been supplied which indicates that leaching rates may not be affected by salinity.

Route and rate of degradation in soil

Mineralization (aerobic)	Since DDACarbonate is considered to be readily biodegradable no data was submitted or required.
Laboratory studies (range or median, with number of measurements, with regression coefficient)	Since DDACarbonate is considered to be readily biodegradable no data was submitted or required.
Field studies (state location, range or median with number of measurements)	Since DDACarbonate is considered to be readily biodegradable no data was submitted or required.
Anaerobic degradation	Since DDACarbonate is considered to be readily biodegradable no data was submitted or required.
Soil photolysis†	A sandy loam soil, 25 ^{o}C, xenon arc lamp with emissions 290 nm – 740 nm in a 12 hour light, 12 hour dark cycle; 30 d incubation – K (light) = 0.00526 d^{-1} K (dark) = 0.00411 d^{-1} K (photolysis only) = 0.00115 d^{-1} DT50 (photolysis only) = 603 d
Non-extractable residues	Increased from 9.48 % to 25.2 % (exposed) and 20.9 % (non-exposed)
Relevant metabolites - name and/or code, % of applied a.i. (range and maximum)	No metabolites were observed.
Soil accumulation and plateau concentration	Since DDACarbonate is considered to be readily biodegradable no data was submitted or required.

† study conducted with DDAC

Adsorption/desorption†

Ka , Kd Ka_{oc} , Kd_{oc} pH dependence (yes / no) (if yes type of dependence)	Kfoc DDAC (adsorption): 437805 mL/ g – 1599564 mL/g; mean = 1103802 mL/g (n=4) 1/n DDAC (adsorption): 0.98 – 1.05; mean 1.01 (n=4) No evidence of pH dependant adsorption

† study conducted with DDAC

Fate and behaviour in air

Direct photolysis in air	No data submitted and not required.
Quantum yield of direct photolysis	No data submitted and not required.
Photo-oxidative degradation in air	Atkinson calculation method using AOPWIN, vers. 1.88. Atmospheric DT_{50} = 8.314 hours in the presence of hydroxyl radicals (24 hour mean Oh concentration of 5 x 10^5 OH radicals cm^{-3})
Volatilization	Vapour pressure: 7.7 x 10^{-3} Pa [25 °C] Henrys Law Constant: 1.78 x 10^{-6} Pa m^3/mol

Monitoring data, if available

Soil (indicate location and type of study)	No data submitted and not required.
Surface water (indicate location and type of study)	No data submitted and not required.
Ground water (indicate location and type of study)	No data submitted and not required.
Air (indicate location and type of study)	No data submitted and not required.

Chapter 5: Effects on Non-target Species

Toxicity data for aquatic species (most sensitive species of each group)

Species	Time-scale	Endpoint	Toxicity[1] (mg l^{-1})
Fish			
Lepomis macrochirus	96 hr	LC_{50}	0.241 (m)
Pimephales promelas	33 d	NOEC	0.015 (m)
Invertebrates			
Daphnia magna	48 hr	EC_{50}	0.057 (m)
Daphnia magna	21 d	NOEC	0.023 (m)
Algae			
Desmodesmus subspicatus	72 hr	NOEC	0.013 (m)
Skeletonema costatum	96 hr	EC_{50}	0.022 (m)
Aquatic plants			
Lemna gibba	7 d	EC_{50}	0.049 (m)
Sediment dwelling organisms			
Leptocheirus plumulosus	10 d	EC_{50}	22.36[2] (n)
Microorganisms			
Activated sludge	3 hour	EC_{50}	43.86 (n)
Activated sludge	3 hour	NOEC	6.88 (n)

[1] Toxicity endpoints converted to DDA+
[2] mg kg^{-1} dw sediment
n = nominal concentration
m = measured concentration

Effects on earthworms or other soil non-target organisms

Acute toxicity to earthworms	*Eisenia foetida andrei*: 14d LC_{50} = > 1000 mg kg^{-1} a.s. dw (n)
Reproductive toxicity to terrestrial plants	Mung bean: Germination 20 d EC_{50} = > 1280 mg kg^{-1} dw soil (n) Survival 20 d EC_{50} = > 1280 mg kg^{-1} soil dw soil (n) Growth 20 d EC_{50} = 1670 mg kg^{-1} dw soil (n) Mustard: Germination 20 d EC_{50} = >1600 mg kg^{-1} dw soil (n) Survival 20 d EC_{50} = >1600 mg kg^{-1} soil dw soil (n) Growth 20 d EC_{50} = 283 mg kg^{-1} dw soil (n) Wheat: Germination 20 d EC_{50} = > 1600 mg kg^{-1} dw soil (n) Survival 20 d EC_{50} = > 1600 mg kg^{-1} soil dw soil (n) Growth 20 d EC_{50} = 857 mg kg^{-1} dw soil (n)
Reproductive toxicity to non-target organisms	No reproduction test with DDACarbonate was carried out.

Effects on soil micro-organisms

Nitrogen mineralization	28 d-EC_0 > 1000 mg a.s. kg^{-1} dw soil (n)
Carbon mineralization	28 d-EC_0 > 1000 mg a.s. kg^{-1} dw soil (n)

Effects on terrestrial vertebrates

Acute toxicity to mammals	
Acute toxicity to birds	*Colinus virginianus* LD_{50} = 95 mg kg^{-1} bw (nominal)
Dietary toxicity to birds	*Coturnix coturnix japonica* LC_{50} = > 5620 mg kg^{-1} (5 days, nominal) *Anas platyrhynchos* LC_{50} = > 5620 mg kg^{-1} (5 days, nominal)
Reproductive toxicity to birds	No reproduction test with DDACarbonate was carried out.

Effects on honeybees

Acute oral toxicity	Not Applicable
Acute contact toxicity	Not Applicable

Effects on other beneficial arthropods

Acute oral toxicity	Not Applicable
Acute contact toxicity	Not Applicable
Acute toxicity to ……..	Not Applicable

Bioconcentration

Bioconcentration factor (BCF)	81 l kg^{-1}
Depuration time(DT_{50}) (DT_{90})	Edible tissue Elimination after 14 Days 57 % Elimination after 18 Days 38 % Non-edible tissue Elimination after 14 Days 71 % Elimination after 18 Days 66 % Whole-body Elimination after 14 Days 67 % Elimination after 18 Days 56 %
Level of metabolites (%) in organisms accounting for > 10 % of residues	

Chapter 6: Other End Points

No other endpoints are available.

Appendix II: List of Intended Uses

DDACarbonate has been evaluated for its intended use in the preservation of timber (PT08).

The product is intended for use by professional operators only.

Product Type	Wood preservative PT 08
Concentration Used	BCC-10 is a water-based concentrate which is diluted down and applied as follows. Use class 1: Open tank dipping at 10 g BCC-10 m^{-2} (1 g DDACarbonate m^{-2}, equivalent to 0.1 kg m^{-3}). Use classes 2 & 3: Open tank dipping at 10 – 28 g BCC-10 m^{-2} (1 – 2.8 g DDACarbonate m^{-2}, equivalent to 0.1 – 0.28 kg m^{-3}) and vacuum pressure impregnation at 5.8 kg BCC-10 m^{-3} (0.58 kg DDACarbonate m^{-3}). Use class 4: Vacuum pressure impregnation at 9.3 kg BCC-10 m^{-3} (0.93 kg DDACarbonate m^{-3}).
Target Organism	Wood rotting basidiomycetes and soft rot fungi, wood discolouring sapstain, blue stain and mould fungi, and wood destroying insects.
Categories of User	Professional
Packaging	BCC-10 is packaged in PVC, polyolefin, teflon, kynar, kalrez or vinyl ester containers. Also transported in 200 kg steel PE-lined shipping container drums.
Type of Application	BCC-10 is applied by vacuum pressure impregnation, dipping and open tank dipping.
Storage	Keep container tightly closed. To maintain product quality, do not store in heat or direct sunlight. Keep in a dry, cool and well-ventilated place.

Data supporting DDACarbonate for its use against the intended target organisms have demonstrated sufficient efficacy for inclusion onto Annex I to be recommended.

To date, there are no known resistance issues when using DDACarbonate against the target organisms.

Appendix III: List of studies

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
Bestari, K.	2001	Determination of the Leachability of Bardac 22C from treated wood. Center for Toxicology, Study No 2000-CT-WL-B22C GLP / Unpublished	Yes	Lonza
Birnschein, K.	2011	Flash point of Carboquat HE. Eurofins Agroscience Services EcoChem GmbH. Study code S11-02901 GLP / Unpublished	Yes	Lonza AG
Brewin, S.	2003a	Didecyldimethylammonium Chloride (DDAC: CAS RN 7173-51-5) Validation of Methodology for the Determination of Residues in Drinking, Ground and Surface Water. Huntingdon Life Sciences, Ltd., Report No. ADB015/033168. Ref No. LR 3702 GLP / Unpublished	Yes	Lonza Ltd.
Brewin, S.	2003b	UnpublishedDidecyldimethylammonium Chloride (DDAC: CAS RN 7173-51-5) Validation of Methodology for the Determination of Residues in Soil. Huntingdon Life Sciences, Ltd., Report No. ADB014/033180. Ref No. LR 3701 GLP / Unpublished	Yes	Lonza Ltd.
Brewin, S.	2010	N,N-Didecyldimethylammonium Carbonate (DDACarbonate: CAS RN 894406-76-9) Validation of Methodology for the Determination of Residues in Surface and Drinking Water. Huntingdon Life Sciences, Ltd., Report No. MZD0011. Ref No. LR 4535 GLP / Unpublished	Yes	Lonza Ltd.
Brooks	2007	Literature Review and Assessment of the Environmental Risks Associated with the Use of ACQ Treated Wood Products in Aquatic Environments. Prepared for the Western Wood Preservers Institute, Vancouver, Canada.	No	Public domain
Campbell, S.M. and Beavers, J.B.	1994a	Didecyl dimethyl ammonium carbonate: an acute toxicity study with the northern bobwhite. Wildlife International Ltd., Project No. 289-112 GLP / Unpublished	Yes	Lonza AG
Campbell, S.M. and Beavers, J.B.	1994b	Didecyl dimethyl ammonium carbonate: a dietary LC50 study with the northern bobwhite. Wildlife International Ltd., Project No. 289-110A GLP / Unpublished	Yes	Lonza AG
Campbell, S.M. and Beavers, J.B.	1994c	Didecyl dimethyl ammonium carbonate: a dietary LC50 study with the mallard. Wildlife International Ltd., Project No. 289-111 GLP / Unpublished	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
Clarke, N.	2004	Didecyldimethylammoniumcarbonate (Carboquat AS): Assessment of the inhibitory effect on the respiration of activated sewage sludge. Safepharm Laboratories Limited, Report102/466 GLP / Unpublished	Yes	Lonza AG
Collins, M.K.	1994a	Didecyldimethylammoniumcarbonate (DDACarbonate) – Evaluation in a static-renewal acute toxicity test with Bluegill Sunfish (*Lepomis macrochirus*). Springborn Laboratories, Inc., Report No. 94-5-5259 GLP / Unpublished	Yes	Lonza AG
Collins, M.K.	1994b	Didecyldimethylammoniumcarbonate (DDACarbonate) – Evaluation in a static acute toxicity test with Rainbow trout (*Oncorhynchus mykiss*). Springborn Laboratories, Inc., Report No. 94-4-5223 GLP / Unpublished	Yes	Lonza AG
Collins, M.K.	1994c	Didecyldimethylammoniumcarbonate (DDACarbonate) – Evaluation in a static-renewal acute toxicity test Sheepshead Minnow (*Cyprinodon variegatus*). Springborn Laboratories, Inc., Report No. 94-4-5223 GLP / Unpublished	Yes	Lonza AG
Collins, M.K.	1994d	Didecyldimethylammoniumcarbonate (DDACarbonate) – Evaluation in a static acute toxicity test with Daphnia magna. Springborn Laboratories, Inc., Report No. 94-5-5257 GLP / Unpublished	Yes	Lonza AG
Collins, M.K.	1994e	Didecyldimethylammoniumcarbonate (DDACarbonate) – Evaluation in a static acute toxicity test with Mysid shrimp (*Mysidopsis bahia*). Springborn Laboratories, Inc., Report No. 94-5-5257 GLP / Unpublished	Yes	Lonza AG
Cox, G.E. and Bailey, D.E.	1975	90-day feeding study in dogs with a quaternary ammonium sanitizer Bardac-22. Food and Drug Research Laboratories, Inc., Study No. 2224 a. Ref No. LON 1256 A GLP / Unpublished	Yes	Lonza AG
Daly, D.	1989	Soil/sediment adsorption-desorption of ^{14}C Didecyldimethylammonium chloride (DDAC). Analytical Bio Chemistry Laboratories, Inc., Report No. 37009 GLP / Unpublished	Yes	Lonza AG
Dawes, C.	2008	Salivary flow patterns and health of hard and soft oral tissues. Journal of American Dental Association, volume 139, no. supplement 2, pages 18-24. Published	No	Public domain
Desjardins, D., MacGregor, J.A., Krueger,	2004a	A 96-hour toxicity test of Bardac 22C50 with the marine diatom (*Skeletonema costatum*). Wildlife International Ltd., Report No. 289A-161	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
H.O.		GLP / Unpublished		
Desjardins, D., MacGregor, J.A., Krueger, H.O.	2004b	A 7-day toxicity test of Bardac 22C50 with duckweed (*Lemna gibba* G3). Wildlife International Ltd., Project No. 289A-159 GLP / Unpublished	Yes	Lonza AG
de Vette, H.Q.M., Hanstveit, R. and J.A. Schoonmade	2001	The assessment of the ecological effects of didecyldimethyl-ammonium chloride. (Guidelines OPPTS 850.5100 Soil Microbial Community Test, OECD 216 and OECD 217 and CTB Section H.4.1). TNO Chemistry, Study No. IMW 99-9048-05 GLP / Unpublished	Yes	Lonza AG
de Vette, H.Q.M., van Asten, J.G. and A.O. Hanstveit	2000	A water/sediment study of didecyldimethylammonium chloride (DDAC) using [^{14}C]-DDAC. TNO Nutrition and Food Research, Study No. IMW-99-9048-01 GLP / Unpublished	Yes	Lonza AG
Dionne, E.	1994	Didecyldimethylammonium carbonate (DDACarbonate) – Evaluation in a static (recirculated) acute toxicity test with Eastern oysters (Crassostrea virginica). Springborn Laboratories, Inc., Report No. 94-4-5240 GLP / Unpublished	Yes	Lonza AG
Downing, J.L.	1993	Aerobic aquatic biodegradation of didecyldimethylammonium chloride using a shake flask test system. ABC Laboratories, Inc., Report No. 40687 LR 2305 GLP / Unpublished	Yes	Lonza AG
Dykes, J. and M. Fennessey	1989a	Hydrolysis of Didecyldimethylammonium chloride (DDAC) as a function of pH at 25°C. ABC Laboratories, Inc., Report No. 37004 LR 1791 GLP / Unpublished	Yes	Lonza AG
Dykes, J. and M. Fennessey	1989b	Determination of the photolysis rate of didecyldimethylammonium chloride (DDAC) in pH 7 buffered solution at 25°C. ABC Laboratories, Inc., Report No. 37005 LR 1793 GLP / Unpublished	Yes	Lonza AG
ECB	2003	Technical Guidance Document on Risk Assessment, in support of Directive 93/67/EEC (Risk Assessment for new notified substances); EC Regulation No. 1488/94 (Risk assessment for existing substances); and Directive 98/8/EC (concerning the placing of biocidal products on the market). Part II. Published	No	Public domain
ECB	2002	**TNsG 2002.** European Commission, DG Environment - Technical Notes for Guidance: Human Exposure to Biocidal Products – Guidance on Exposure Estimation (June 2002). Published	No	Public domain

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
Fackler, P.H.	1990	Bioconcentration and elimination of ^{14}C residues by bluegill *(Lepomis machrochirus)* exposed to didecyldimethylammonium chloride (DDAC). Springborn Laboratories, Inc., Report No. 89-7-3043 GLP / Unpublished	Yes	Lonza AG
Fennert, E.M.	2006a	DDA Carbonate 250T: Test according to EN 1275 (05/97). Chemical disinfectants and antiseptics. Fungicidal effect. Test method and requirements (Phase 1). Determination of fungistasis by MIC-test (minimal inhibitory concentration). Lonza GmbH, 32/05/8741/01 GLP / Unpublished	Yes	Lonza Ltd.
Fennert, E.M.	2006b	DDA Carbonate 250T: Test according to EN 1275 (05/97). Chemical disinfectants and antiseptics. Fungicidal effect. Test method and requirements (Phase 1). Determination of fungistasis by MIC-test (minimal inhibitory concentration). Lonza GmbH, 32/05/8741/07 GLP / Unpublished	Yes	Lonza Ltd.
Fennert, E.M. and Wessely, S.	2006	DDA Carbonate 250T: Determination of the protective effectiveness against wood destroying basidiomycetes according to EN 113 (11/96) after leaching procedure according to EN 84 (05/97). Lonza GmbH, 32/05/8741/05 GLP / Unpublished	Yes	Lonza AG
Fennert, E.M. and Doblinski, M.	2005a	DDA Carbonate 250T: Determination of the toxic values against recently hatched larvae of *Hylotrupes bajulus* (*L.*) according to EN 47 (06/2005) – without accelerated ageing procedures. Lonza GmbH, 32/05/8741/02 GLP / Unpublished	Yes	Lonza AG
Fennert, E.M. and Doblinski, M.	2005b	DDA Carbonate 250T: Determination of the toxic values against recently hatched larvae of *Hylotrupes bajulus* (*L.*) according to EN 47 (06/2005) – after leaching procedure according to EN 84 (05/97). Lonza GmbH, 32/05/8741/03 GLP / Unpublished	Yes	Lonza AG
Fiebig, S.	2008	DDACarbonate (concentrate), Ready biodegradability, Modified Sturm Test. Dr. U. Noack-Laboratorien, Study No. AST119591 LR 4229 GLP / Unpublished	Yes	Lonza AG
Fiebig, S.	2006	Dodigen 1881, Ready biodegradability, Modified Sturm Test. Dr. U. Noack-Laboratorien, Study No. AST97952 GLP / Unpublished	Yes	Lonza AG
Flanders, L.	2005	Didecyldimethylammoniumcarbonate (Carboquat AS): L5178Y TK+/- mouse lymphoma assay. Safepharm Laboratories Limited, Report No. 102/484 Ref No. LR 3898	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
		GLP / Unpublished		
Gill, M.W., Chun, J.S., Wagner, C.L.	1991a	Chronic dietary toxicity/oncogenicity study with Didecyldimethylammonium Chloride in rats. Union Carbide, Report No. 53-566. Ref No. LON 1755 GLP / Unpublished	Yes	Lonza AG
Gill, M.W., Hermansky, S.J., Wagner, C.L.	1991b	Chronic dietary oncogenicity study with Didecyldimethylammonium Chloride in mice. Union Carbide, Report No: 53-528 Ref No.: LON 1776 GLP / Unpublished	Yes	Lonza AG
Gill, M.W. and Van Miller. J.P.	1988	Ninety-day subchronic dermal toxicity study with Didecyldimethylammonium Chloride in rats. Union Carbide, Project No: 51-554 Ref No.: LON 1255 GLP / Unpublished	Yes	Lonza AG
Gray, J.	2004	N,N-Didecyl-N,N-dimethylammonium chloride (DDAC): Acute toxicity to terrestrial plants. Huntingdon Life Sciences, Study No. DKG/014 GLP / Unpublished	Yes	Lonza AG
Henzen, L.	1999	The acute toxicity of DDAC to the worm species *Eisenia fetida* in a 14-day test (OECD Guideline No. 207). TNO Nutrition and Food Research Institute, Report No. V99.160 GLP / Unpublished	Yes	Lonza AG
Hirschen, D.M., Ziemer, M. and D. Seifert	1998	Bardac 22: DOC die-away test OECD 301 A with pre-adapted inoculum. Clariant GmbH, Report No. D0094-1 GLP / Unpublished	Yes	Lonza AG
Howes, D.	2004	DDAC (CAS RN 7173-51-5) Estimation of Photodegradation Using the Atmospheric Oxidation Program (AOPWIN). Huntingdon Life Sciences, DKG/016 GLP / Unpublished	Yes	Lonza AG
Jin, L.	1997	ACQ Leaching Study for Use in Aquatic Environmental Risk Assessment. CSI project AQ/P40. Chemical Specialties, Inc. 5910 Pharr Mill Road, Harrisburg, North Carolina 28075. 4 pp.	No	Public domain
Keipert, W.	2001	Determination of the Thermal Stability and Stability in Air of Dodigen 1881 AS (Bardac 22 AS) in accordance with OECD-Guideline 113. Clariant GmbH AllessaChemie GmbH, Report No. B 012/2001. Ref No. LR 3449 GLP / Unpublished	Yes	The Dialkyl Project
Kukulinksi, M.	2003	Skin Sensitization Study of Maquat 4480-E, Batch #30717J5, OPPTS 870.2600.	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
		Tox Monitor Laboratories, Inc., Project ID. 03-092-5 Ref. No. D155 (LON 4003) GLP / Unpublished		
McBain, A.J. *et al*	2004	Effects of quaternary-ammonium-based formulations on bacterial community dynamics and antimicrobial susceptibility. Appl. Environ. Microbiol. 70 (6), 3449-3456. Non-GLP / Published	No	Public domain
Merkel, D.J.	2006	21-Day Repeated Dose Dermal Irritation Study With Carboquat in Female Rats. Product Safety Laboratories, Report No. 19072 Reference No. LR 4019 GLP / Unpublished	Yes	Lonza AG
Merkel, D.J.	2004	Bardac 2280: Dermal Sensitization Study in Guinea Pigs (Buehler Method). Product Safety Laboratories, Study No. 15512 Ref. No. D154 (LON 4005). GLP / Unpublished	Yes	Lonza AG
Morris, T.D.	1994a	Acute Oral Toxicity in Rats – Median Lethal Dosage Determination Using a 5% Active Ingredient Formulation of Didecyl Dimethyl Ammonium Carbonate. Hill Top Biolabs, Inc., Report No. 93-8185-21 (A) Ref No. LR 3718 GLP / Unpublished	Yes	Lonza AG
Morris, T.D.	1994b	Primary Skin Irritation Study in Rabbits using a 50% Active Ingredient Formulation of Didecyl Dimethyl Ammonium Carbonate. Hill Top Biolabs, Inc., Report No. 93-8185-21 (C) Ref No. LR 3717 GLP / Unpublished	Yes	Lonza AG
Morris, T.D.	1994c	Photoallergy Study with Didecyl Dimethyl Ammonium Carbonate in Guinea Pigs. Hill Top Biolabs, Inc., Report No. 93-8123-21 (A) Ref No. LR 3716 GLP / Unpublished	Yes	Lonza AG
Neeper-Bradley, T.L.	1991a	Developmental toxicity evaluation of Didecyldimethylammonium Chloride administered by gavage to CD® (Sprague-Dawley) rats. Union Carbide, Project No: 53-534 Ref No. LON 1781 GLP / Unpublished	Yes	Lonza AG
Neeper-Bradley, T.L.	1991b	Two-generation reproduction study in Sprague-Dawley rats (CD®) with didecyldimethylammonium chloride administered in the diet. Union Carbide, 52-648 GLP / Unpublished	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
OECD	2003	Emission Scenario Document for Wood Preservatives (parts 1-4)	No	Public domain
Osheroff, M.R.	1990	Subchronic oral toxicity study of Didecyldimethylammonium Chloride in dogs. Hazelton Laboratories America, Inc., Study No. 2545-100 Ref No. LON 1256 GLP / Unpublished	Yes	Lonza AG
Palmer, S.J., MacGregor, J.A., Krueger, H.O.	2004a	An early life-stage toxicity test of Bardac 22C50 with the Fathead minnow (*Pimephales promelas*). Wildlife International Ltd., Report No. 289A-155 GLP / Unpublished	Yes	Lonza AG
Palmer, S.J., MacGregor, J.A., Krueger, H.O.	2004b	A flow-through life-cycle toxicity study of Bardac 22C50 with the cladoceran (Daphnia magna). Wildlife International Ltd., Project No. 289A-162 GLP / Unpublished	Yes	Lonza AG
Roper, C. S.	2001	The In Vitro Percutaneous Absorption of [^{14}C]-Didecyldimethylammonium Chloride (DDAC) Through Human Skin. Inveresk Research, Report No. 19128 Ref No. LON 3329 GLP / Unpublished	Yes	Lonza AG
Sanders, A.	2004	Didecyldimethylammoniumcarbonate (Carboquat technical): acute dermal toxicity (limit test) in the rat. Safepharm Laboratories Limited, SPL Project No. 102/461 Ref No. LR 3900 GLP / Unpublished	Yes	Lonza AG
Schmidt, J.	1992	Determination of the photolysis rate of didecyldimethylammonium chloride on the surface of soil. ABC Laboratories, Inc., Report No. 39505 LR 3069 GLP / Unpublished	Yes	Lonza AG
Schulze, G.E.	1991	Chronic oral toxicity study of Didecyldimethylammonium Chloride in dogs. Hazelton Washington, Inc., Study No. 2545-102. Ref No. LON 1778 GLP / Unpublished	Yes	Lonza AG
Schaefer E.C.	1996	Aerobic aquatic biodegradation test with didecyldimethylammonium chloride (DDAC) and a bentonite clay:DDAC complex conducted with natural sediment and site water. Wildlife International Ltd., Project No. 434E-101 LR 2923 GLP / Unpublished	Yes	Lonza AG
Selim, S.	1989	Absorption, Distribution, Metabolism and Excretion Studies of Didecyldimethylammonium Chloride (DDAC) in the Rat. Biological Test Center, Study No. P01421. Ref Nos. LON 1779	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
		GLP / Unpublished		
Still, M.G.	1995	Didecyl Dimethyl Ammonium Carbonate One Year Storage Stability. Lonza Inc. Research and Development. Project No. PST-033 Lonza Report No.: 3730 GLP / Unpublished	Yes	Lonza AG
Thomas, S., Krueger, H.O., MacGregor, J.A., Nixon, W.B.	2004a	A survival and growth sediment acute toxicity test with *Chironomus tentans* using sediment spiked with Bardac 22C50. Wildlife International Ltd., Project No. 289A-156 LR 3901 GLP / Unpublished	Yes	Lonza AG
Thomas, S., Krueger, H.O., MacGregor, J.A., Nixon, W.B.	2004b	A survival and growth sediment acute toxicity test with *Leptocheirus plumulosus* using sediment spiked with Bardac 22C50. Wildlife International Ltd., Project No. 289A-157 GLP / Unpublished	Yes	Lonza AG
Thompson, P.W.	2004	Didecyldimethylammoniumcarbonate (Carboquat): reverse mutation assay "Ames Test" using *Salmonella typhimurium.* Safepharm Laboratories Limited, Report/Project No. 102/464 Reference No. LR 3889 GLP / Unpublished	Yes	Lonza AG
Tremain SP	2004	Didecyldimethylammoniumcarbonate (Carboquat AS): Determination of hazardous physico-chemical properties. Safepharm Laboratories Limited, SPL Project Number: 102/460. Reference No. LR 3899 GLP / Unpublished	Yes	Lonza Ltd.
Truong D	2011a	Methods Validation of Didecyldimethyl Ammonium Carbonate and its Impurities. Eurofins Product Safety Laboratories, Study No. 31313 Report No. 4747 GLP / Unpublished	Yes	Lonza AG
Truong D	2011b	Preliminary Analysis Eurofins Product Safety Laboratories, Report No. 31467 Ref No. LR 4752 GLP / Unpublished	Yes	Lonza AG
Tyl, R.W.	1989	Developmental toxicity study of Didecyldimethylammonium Chloride administered by gavage to New Zealand white rabbits. Union Carbide, Project No. 51-590 Ref No. LON 1770 GLP / Unpublished	Yes	Lonza AG
Van Miller, J.	1988a	Ninety-day dietary subchronic oral toxicity study with Didecyldimethylammonium Chloride in rats.	Yes	Lonza AG

Author(s)	Year	Title Source (where different from company) Testing Company, Report No. GLP (where relevant) / (Un)Published	Data Protection Claimed (Yes/No)	Owner
P.		Union Carbide, Report No. 51-506 Ref No. LON 1257 GLP / Unpublished		
Van Miller, J. P.	1988b	Subchronic dietary dose range finding study with Didecyldimethylammonium Chloride in mice. Union Carbide, Report No. 51-507 Ref No, LON 1775 GLP / Unpublished	Yes	Lonza AG
Vryenhoef, H, and McKenzie, J.	2004	Didecyldimethylammoniumcarbonate (Carboquat AS): algal growth inhibition test. Safepharm Laboratories Limited, Report No. 102/465 GLP / Unpublished	Yes	Lonza AG
Watanabe S, Ohnishi M, Imai K, Kawano E and Igarashi, S	1995	Estimation of the total saliva volume produced per day in five-year-old children. Archives of Oral Biology, volume 40, issue 8, August 1995, pages 781-782. Published	No	Public domain
Wo, C	2005	Bardac 22C50 - Storage stability and corrosion characteristics. Product Safety Laboratories. Report No. 4375 Unpublished	Yes	Lonza Ltd.
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