3.9 NEUROTOXICITY

Remark	Reference
There is a substantial volume of data available on the toxicity of carbon dioxide, and none of it indicates that carbon dioxide may have neurotoxic effects. It is on this basis that it is not necessary to submit additional toxicity data about the neurotoxicity of carbon dioxide.	Document III-A6 Section 6.9

3.10 HUMAN DATA

Effects of excessive carbon dioxide exposure in man are well reported in the product literature. These studies have been summarised in Document IIIA Section 6.1.3, 6.4.3, 6.5 and 6.12. The key results for man include the following:

Exposure to 1% carbon dioxide (time weighted average) during the working day has little effect on blood parameters, including bicarbonate and carbon dioxide. (It should be noted that the author of the study had great difficulty in monitoring the exposure of subjects to carbon dioxide because of their movements).

Exposure to 1.5% carbon dioxide led to lower heart rate, reduced tolerance to vigorous exercise. There was no apparent changes in performance or basic physiological parameters when humans were exposed to 1.5% carbon dioxide for 42 days. There was slight acidosis for 23 days, increased respiratory rate and increased systolic BP.

Exposure to 3% carbon dioxide leads to deeper breathing, headache, reduced hearing ability, increased heart rate and acidosis.

At 5-10% carbon dioxide, in addition to the effects detailed for exposure to 3% carbon dioxide there is more laborious breathing and loss of judgement.

At 10% carbon dioxide , in addition to the symptoms detailed for 5-10% carbon dioxide, there is also loss of consciousness.[7]

It has been widely reported that the effects associated with carbon dioxide exposure are reversible once the carbon dioxide has been removed.

The normal working practices of carbon dioxide as an insecticide fumigant are within a sealed enclosure (fumigation bubble) and therefore additional exposure to the gas is not expected.

In addition to the above, the potential for exposure to carbon dioxide is minimal as it is manufactured [redacted] This means there is no exposure to workers, bystanders or the environment, during manufacture.

3.11 OTHER TOXICOLOGICAL EFFECTS

Remark	Reference
There is a substantial volume of data available on the toxicity of carbon dioxide, and none of it indicates that carbon dioxide is of sufficient concern to justify further investigation by a mechanistic study, or by routes of administration that are not considered in the core toxicity data set. In addition, carbon dioxide is not mixed or added to any other chemicals during it's normal use so it is not necessary to provide data on degradation products, by-products and reaction products relating to the human exposure to carbon dioxide. It is not necessary to submit data to consider the toxicity of carbon dioxide in food or feeding stuffs because although carbon dioxide is used on certain foodstuffs: 1. Once the fumigation process has been completed and all the carbon dioxide vented away to atmosphere, there will be no carbon dioxide residues remaining. Measuring and detection devices are used to monitor carbon dioxide levels present during and after a fumigation has occurred. 2. Due to the fact that no carbon dioxide residues are left on ingredients, finished food products or on equipment, carbon dioxide was granted exemption from food residue tolerance by the US Environmental Protection Agency (EPA) in 1980 when used on all raw agricultural commodities. 3. Carbon dioxide is classified as a Permitted Miscellaneous Additive in Foods (Serial no, E290) without stated limits other than those consistent with responsible manufacturing procedures. Carbon dioxide is also not intended for use directly on plants, making it unnecessary to consider the toxic effect of metabolites from treated plants. The normal working practices of carbon dioxide as an insecticide fumigant are within a sealed enclosure (fumigation bubble) and therefore additional exposure to the gas is not expected. In addition to the above, the potential for exposure to carbon dioxide is minimal as it is manufactured [redacted] This means there is no exposure to workers, bystanders or the environment, during manufacture.	Document III-A6 Section 6.10 Document III-A6 Section 6.11 Document III-A6 Section 6.14 Document III-A6 Section 6.15 Document III-A6 Section 6.16 Document III-A6 Section 6.17

4 ENVIRONMENTAL EFFECTS ASSESSMENT

4.1 FATE AND DISTRIBUTION IN THE ENVIRONMENT

4.1.1 Degradation

4.1.1.1 Biodegradation (1 of 3)

Guideline / Test method	Test type	Test parameter	Inoculum			Additional substrate	Test substance conc.	Degradation		Remarks	Reference
			Type	Conc	Adaptation			Incubation period	Degree [%]		
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. Ready Biodegradability [1] Carbon dioxide does break down in water to give carbonic acid: $CO_2 + H_2O \surd H_2CO_3$ This, however, is not brought about by biological means, as it will happen as the result of the simple dissolution of the carbon dioxide in water. Testing for the ready biodegradability of carbon dioxide is scientifically unjustified. Carbon dioxide evolution is one of the major end-points used in such biodegradability tests. Ready biodegradability describes the conversion of test substances to carbon dioxide; thus recognising that there will not normally be any further degradation.	Document III-A Section 7.1.1.2.1

4.1.1.1 Biodegradation (2 of 3)

Guideline / Test method	Test type	Test parameter	Inoculum			Additional substrate	Test substance conc.	Degradation		Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Inherent Biodegradability [1] Inherent biodegradability is technically not possible to perform on carbon dioxide as the test methods are designed to work with water-soluble, non volatile organic substances. Carbon dioxide, although water soluble, is volatile and inorganic.	Document III-A Section 7.1.1.2.2

Footnotes

1. Due to the ready biodegradability and inherent biodegradability of carbon dioxide, it is not scientifically necessary to determine the rate and route of carbon dioxide degradation in aquatic systems (the data end points detailed in Document III-A, 7.1.2, 7.1.2.2.1 and 7.1.2.2.1).

4.1.1.1 Biodegradation (3 of 3)

Guideline / Test method	Test type	Test parameter	Inoculum			Additional substrate	Test substance conc.	Degradation		Remarks	Reference
			Type	Conc	Adaptation			Incubation period	Degree [%]		
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. <u>Biodegradation in sea water</u> Data on biodegradation in seawater is not required, as carbon dioxide is not intended to be either used or released into marine environments. For these purposes, it is intended that carbon dioxide be used as a biocide in a closed system.	Document III-A Section 7.1.1.2.3
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. <u>Biological sewage treatment – aerobic and anaerobic biodegradation</u> Aerobic biodegradation in biological sewage treatment is not applicable, as carbon dioxide is not intended to enter sewage treatment plants before release to the environment. Anaerobic biodegradation is not applicable, as carbon dioxide is not intended to be exposed to anaerobic conditions. For these purposes, it is intended that carbon dioxide be used as a biocide in a closed system.	Document III-A Section 7. 1.2.1.1 Document III-A Section 7.1.2.1.2

4.1.1.2 Abiotic Degradation

Hydrolysis

Guideline /Test Method	pH	Temperature [°C]	Initial TS concentration C_0 [mol/l]	Reaction rate Constant, K_h [1/s x 10^5]	Half-life, DT_{50} [h]	Coefficient of correlation, r_2	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. Further work or studies are not considered scientifically justified as the chemistry of carbon dioxide is well known and this result can be predicted from the intrinsic properties of carbon dioxide. Carbon dioxide is moderately soluble in water and at 20°C; 88 ml of carbon dioxide will dissolve in 100 ml of water. Some of this dissolved carbon dioxide will react with water to form carbonic acid. $CO_2 + H_2O \surd H_2CO_3$ Carbonic acid will undergo further reactions to produce bicarbonate and carbonate ions $H_2CO_3 + OH^- \surd HCO^-_3 + H_2O$ $HCO^-_3 + OH^- \surd CO_3^{2-} + H_2O$ Thus, an aqueous solution of carbon dioxide will contain mainly carbon dioxide, with a small amount of carbonic acid, bicarbonate ions and carbonate ions. No further reactions will take place in the absence of other chemicals. The equilibrium constant for the disassociation reaction is 600, which means that there is 600 times more carbon dioxide in solution than is converted to carbonic acid. This will not change with time, so carbon dioxide can be considered to be hydrolytically stable. It should be noted that each of the reactions described above is reversible and equilibrium will exist for each. The introduction or removal of even a tiny amount of any of the chemical species in the reactions described will cause the equilibria to be disturbed and change the concentrations of all the chemical species in the reaction. For this reason, it would be necessary to conduct the experiment in a sealed system with some sort of in-built analysis capability for whichever of the ions are to be monitored. The concentration of these ions is likely to be so low that they cannot be accurately measured without removing them from the system and thus disturbing the equilibria.	Document III-A Section 7.1.1.1.1

Photolysis in water

Guideline/ Test Method	Initial Molar TS concentration	Total Recovery of Test Substance [% of appl. a.s.]	Photolysis rate constant (k^c_p)	Direct photolysis sunlight rate constant (K_{pE})	Reaction quantum yield (0^c_E)	Half-life ($t_{1/2E}$)	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. The US EPA method entitled Fate, Transport and Transformation Test Guidelines OPPTS 835.2210 Direct Photolysis Rate in Water by Sunlight states that the test method is applicable to all chemicals which have a UV/absorption maxima in the range of 290-800nm. Carbon dioxide has a UV absorption maxima of approximately 140 nm and as such this test is not technically feasible to perform.	Document III-A Section 7.1.1.1.2

Phototransformation in air

Guideline/ Test Method	Initial Molar TS concentration	Total Recovery of Test Substance [% of appl. a.s.]	Photolysis rate constant (k^c_p)	Direct photolysis sunlight rate constant (K_{pE})	Reaction quantum yield (0^c_E)	Half-life ($t_{1/2E}$)	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	As a gas under all environmental conditions that are likely to occur on earth, carbon dioxide will occur predominately in air. Carbon dioxide is a by-product of aerobic respiration There is a natural "carbon cycle" whereby carbon dioxide is continuously added and removed from the environment through natural processes.	Document III-A Section 7.3.1 Document III-A Section 7.3.2

4.1.1.3 Distribution

Absorption onto/desorption from soils (1 of 2)

Guideline/ test method	Absorbed a.s. [%]	K_a [1]	K_{aOC} [2]	K_d [3]	K_{dOC} [4]	K_a / K_d [5]	Degradation products Name	[%] of a.s.	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	In water, carbon dioxide breaks down to give carbonic acid, which is brought about by the result of simple dissolution of the carbon dioxide in water. $CO_2 + H_2O \surd H_2CO_3$ It will attain equilibrium with air spaces in soil through passive diffusion. The normal working practices of carbon dioxide as an insecticide fumigant are within a sealed enclosure (fumigation bubble) and therefore additional exposure to the gas is not expected. For the reasons detailed above, it is not necessary to conduct an adsorption/desorption screening test for carbon dioxide.	Document III-A Section 7.1.3 Document III-A Section 7.1.4 Document III-A Section 7.1.4.1

Key
1. K_a = Adsorption coefficient.
2. K_{aOC} = Adsorption coefficient based on organic carbon content.
3. K_d = Desorption coefficient.
4. K_{dOC} = Desorption coefficient based on organic carbon content.
5. K_a/K_d = Adsorption/desorption distribution coefficient.

Absorption onto/desorption from soils (2 of 2)

Guideline/ test method	Absorbed a.s. [%]	K_a [1]	K_{aOC} [2]	K_d [3]	K_{dOC} [4]	K_a / K_d [5]	Degradation products Name	Degradation products [%] of a.s.	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. <u>Additional soil studies (as detailed in data requirements 7.2.1, 7.2.2, 7.2.2.1, 7.2.2.2, 7.2.2.3, 7.2.2.4, 7.2.3, 7.2.3.1, 7.2.3.2)</u> Data on fate and behaviour in soil is not required as carbon dioxide is not intended to be either used or released directly to the soil and therefore these studies are not required. The data end points for ready biodegradability (7.1.1.2.1) and inherent biodegradability (7.1.1.2.2) do not indicate the need to conduct studies on the fate and behaviour of carbon dioxide in soil. In addition, this is substantiated by the fact that that carbon dioxide does undergo a degree of abiotic degradation by means of simple dissolution in water. Also, it is well known that although carbon dioxide occurs predominately in air, it will attain equilibrium with air spaces in soil through passive diffusion.	Document III-A Section 7.2.1 7.2.2 7.2.2.1 7.2.2.2 7.2.2.3 7.2.2.4 7.2.3 7.2.3.1 7.2.3.2
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<u>Bioconcentration in soil</u> Carbon dioxide is naturally present in the soil. It is constantly produced by soil-dwelling organisms as a result of the numerous metabolic reactions involving carbon-containing compounds. Carbon dioxide is also naturally produced in the soil during the process of decomposition. Soil dwelling organisms are exposed to carbon dioxide in the soil without any toxic effects.	Document III-A Section A7.5.5 Document III-A Section A7.5.5.1

Key

1. K_a = Adsorption coefficient.
2. K_{aOC} = Adsorption coefficient based on organic carbon content.
3. K_d = Desorption coefficient.
4. K_{dOC} = Desorption coefficient based on organic carbon content.
5. K_a/K_d = Adsorption/desorption distribution coefficient.

4.1.2 Accumulation

Measurements of aquatic bioconcentration

Guideline /Test method	Exposure	Log Pow of a.s.	Initial concentration of a.s.	Steady-state BCF	Uptake rate constant	Depuration rate constant	Depuration time (DT_{50})	Metabolites	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. "Bioconcentration" is the process leading to a higher concentration of, for example, a pesticide in an organism than in environmental media to which it is exposed. Since CO_2 is a naturally occurring substance that all living organisms are exposed to, and which plays a vital role in the normal maintenance of life, studies into the bioconcentration of carbon dioxide are not justified. The partition coefficient of CO_2 is 0.83.	Document III-A Section 7.4.2

Estimations on aquatic bioconcentration

Basis for estimation	Log Pow (measured)	Estimated BCF for fish (freshwater)	Estimated BCF for fish eating bird/predator	Remarks	Reference
N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. "Bioconcentration" is the process leading to a higher concentration of, for example, a pesticide in an organism than in environmental media to which it is exposed. Since CO_2 is a naturally occurring substance that all living organisms are exposed to, and which plays a vital role in the normal maintenance of life, studies into the bioconcentration of carbon dioxide are not justified. The partition coefficient of CO_2 is 0.83.	Document III-A Section 7.4.2

Estimation on terrestrial bioconcentration

Basis for estimation	Log Pow (measured)	Estimated BCF for				Remarks	Reference
		Terrestrial food chain I		Terrestrial food chain II			
		Soil dwelling species	Predatory bird /vertebrate	Terrestrial plant	Grazing non-target organism		
N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. "Bioconcentration" is the process leading to a higher concentration of, for example, a pesticide in an organism than in environmental media to which it is exposed. Since CO_2 is a naturally occurring substance that all living organisms are exposed to, and which plays a vital role in the normal maintenance of life, studies into the bioconcentration of carbon dioxide are not justified. The partition coefficient of CO_2 is 0.83.	Document III-A Section 7.4.2

4.2 EFFECT ON ENVIRONMENTAL ORGANISMS

4.2.1 Aquatic compartment

Acute toxicity to fish

Guideline/ Test method	Species	Endpoint/ Type of test	Exposure Design	Duration	Results LC_0 LC_{50} LC_{100}	Remarks	Reference
No set guideline followed. Refer to "Exposure Design" for summary of methodology followed.	Brook Trout (*Salvelinus fontinalis)* Slimy Sculpin (*Cottus cognatus*) Blacknose dace (*Rhinichthys atratulus)*	Rather than looking at acute toxicity *per se*, this test investigated the physiological and behavioural effects of fish exposed to carbon dioxide.	3 replicates of 4 different CO_2 levels were tested in treatment vessels. Dose levels of CO_2 were 1.4%, 2.8% and 5.1%. Substrate cover of flat creekbed stones (5-15 cm) was provided in each tank; floe maintained at 6 l/min and water volume 85 l. CO_2 was measured throughout the test period, and adjustments made periodically to maintain treatments at or near prescribed points. After tests, fish were monitored for 1 week to assess short-term mortality.	24 h	Rather than looking at acute toxicity *per se,* this test investigated the physiological and behavioural effects of fish exposed to carbon dioxide. The results show that physiological responses to exposure to increased carbon dioxide in fish differed by species when they were exposed to 1.4%, 2.8% and 5.1% CO_2. However recovery to pre-treatment activity rates of most behaviour patterns (including feeding) was observed 24h after cessation of exposure in all 3 test species.	This study gives an indication about the possible physiological and behavioural effects that increased levels of CO_2 may have on fish. It is not considered necessary to conduct further studies on the toxicity of CO_2 to fish. [1,2,3]	Document III-A Section 7.4.1.1

Footnotes

1. Due to the results available on the acute toxicity of carbon dioxide to fish, coupled with the fact that there is no exposure to the aquatic environment, it is not necessary to submit further studies on the effects of carbon dioxide to aquatic organisms (the data requirements detailed in Document III-A, 7.4.3). It is also not necessary to submit data on prolonged toxicity of carbon dioxide to fish (Document III-A, 7.4.3.1).

2. Due to the results available in the core base set of environmental toxicity data for carbon dioxide, particularly that available on the acute toxicity to fish and the fact that there is no exposure to the aquatic environment, it is not necessary to submit further studies on the effects of carbon dioxide on the reproduction and growth rate of fish (the data requirements detailed in Document III-A, 7.4.3.2).

3. Due to the fact that there is no exposure to the aquatic environment, coupled with the fact that there is no data available which suggests that carbon dioxide will bioaccumulate in the environment, nor is there a risk of secondary poisoning through the use of carbon dioxide, it is not necessary to submit data on bioaccumulation in fish (the data requirements detailed in Document III-A 7.4.3.3.1).

Acute toxicity to invertebrates

Guideline/ Test method	Endpoint / Type of test	Exposure Design	Exposure Duration	Results LC_0	Results LC_{50}	Results LC_{100}	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Already submitted for carbon dioxide dossier for Product Type 14. In principle, invertebrates will be expected to show similar physiological tolerances to carbon dioxide as those exhibited by fish (refer to table above for details). There is no underlying reason why aquatic invertebrates should be more sensitive, and so the generation of additional test data is unjustified. [1,2,3]	Document IIIA Section 7.4.1.2

Footnotes

1. Due to the results available on the acute toxicity of carbon dioxide to fish (which can be applied to invertebrates), coupled with the fact that there is no exposure to the aquatic environment, it is not necessary to submit further studies on the effects of carbon dioxide to aquatic organisms (the data requirements detailed in Document III-A, 7.4.3). It is also not necessary to submit data on prolonged toxicity of carbon dioxide to fish (Document III-A, 7.4.3.1).
2. Due to the fact that there is no exposure to the aquatic environment, coupled with the fact that there is no data available which suggests that carbon dioxide will bioaccumulate in the environment, nor is there a risk of secondary poisoning through the use of carbon dioxide, it is not necessary to submit data on bioaccumulation in invertebrate species (the data requirements detailed in Document III-A 7.4.3.3.2).
3. Due to the results available in the core base set of environmental toxicity data for carbon dioxide, particularly that available on the acute toxicity to fish (which can be applied to invertebrates) and the fact that there is no exposure to the aquatic environment, it is not necessary to submit further studies on the effects of carbon dioxide on the reproduction and growth rate of invertebrates (the data requirements detailed in Document III-A, 7.4.3.4).

Growth inhibition on algae

Guideline/ Test method	Species	Endpoint / Type of test	Exposure Design	Exposure Duration	Results NOE_rC	Results E_bC_{50} [1]	Results E_rC_{50} [2]	Remarks	Reference
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	It is not scientifically necessary to calculate the growth inhibition of carbon dioxide to algae, because carbon dioxide is an essential substrate for photosynthesis.	Document IIIA Section 7.4.1.3

Key

1. Calculated from the area under the growth curve
3. Calculated from growth rate
4.

Footnotes

1. Due to the results available on the toxicity of carbon dioxide to algae, coupled with the fact that there is no exposure to the aquatic environment, it is not necessary to submit further studies on the effects of carbon dioxide to aquatic organisms (the data requirements detailed in Document III-A, 7.4.3). It is also not necessary to submit data on prolonged toxicity of carbon dioxide to fish (Document III-A, 7.4.3.1).

Inhibition of microbial activity (aquatic)

Guideline / Test method	Species / Inoculum	Endpoint/ Type of test	Exposure		Results			Remarks	Reference
			Design	Duration	EC_{20}	EC_{50}	EC_{80}		
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Whist elevated levels of carbon dioxide may affect environmental conditions for bacteria by reducing pH, there are a number of mitigating factors that would reduce any environmental impacts of such changes and make it unnecessary to generate new test data. (a) Most free living prokaryotic bacteria can tolerate a pH range of about 3 units (three orders of magnitude changes in pH). (b) There is a high level of functional redundancy amongst mixed communities of micro-organisms such that declines in population of some species e.g. due to unfavourable pH conditions, will be compensated for by increases in others. The effect of this biological diversity and different environmental optima for different species means that most bacteria can live in a wide range of pH conditions, from 0.5-9.0.	Document IIIA Section 7.4.1.4

Footnotes

1. Due to the results available on the toxicity of carbon dioxide to aquatic microbes, coupled with the fact that there is no exposure to the aquatic environment, it is not necessary to submit further studies on the effects of carbon dioxide to aquatic organisms (the data requirements detailed in Document III-A, 7.4.3). It is also not necessary to submit data on prolonged toxicity of carbon dioxide to fish (Document III-A, 7.4.3.1).

Effects on sediment dwelling organisms

Remarks	Reference
This information is only required if the active substance partitions to, and persists in, aquatic sediments, such that sediment dwelling organisms are likely to be exposed to the active substance. Concentrations of carbon dioxide in the water/sediment ecosystem vary greatly depending upon factors such as temperature and organic matter content.	Document IIIA Section 7.4.3.5.1

Aquatic Plant Toxicity

Remarks	Reference
It should be noted that carbon dioxide plays a vital role in the photosynthesis pathway of plants. It is widely accepted that commercial horticulturists use carbon dioxide to enrich the atmospheres of their greenhouses and other growing environments to accelerate the growth of crops.	Document IIIA Section 7.4.3.5.2

4.2.2 Atmosphere

4.2.3 Terrestrial compartment

Toxicity to terrestrial organisms, initial tests (1 of 5)

Guideline/ Test method	Species	Endpoint / Type of test	Exposure		Results			Remarks	Reference
			Design	Duration	NOEC	LOEC	EC/LC_{50}		
N/A	Microbes, terrestrial	N/A	N/A	N/A	N/A	N/A	N/A	This data is only required if a concern for the terrestrial compartment is indicated by the risk assessment or if there is likely to be long-term exposure to the active substance. There is no mechanism for the carbon dioxide to be released directly into terrestrial systems. Consequently, there will be no increased levels of carbon dioxide in terrestrial systems making it unnecessary to determine the effect of increased carbon dioxide on microbial activity.	Document IIIA Section 7.5.1.1

Toxicity to terrestrial organisms, initial tests (2 of 5)

Guideline/ Test method	Species	Endpoint / Type of test	Exposure Design	Exposure Duration	Results NOEC LOEC EC/LC_{50}	Remarks	Reference
No set guideline followed. Refer to "Exposure Design" for summary of methodology followed.	Earthworm (test species was a natural population of surface casting earthworm. Exact species not given)	Rather than investigating acute toxicity *per se*, this study investigated the effects of increased CO_2 on cast production.	Carbon dioxide was added to soil plots using a screen aided CO_2 control facility. Control plots contained 350µm CO_2 while test plots contained an increased level of CO_2 (610 µm) in natural soil	2 years.	NOEC, LOEC, EC_{50} or LC_{50} not given because test was not investigating acute toxicity *per se*. Exposure to increased levels of CO_2 caused rates of surface cast production to increase 6 fold. Cumulative surface cast production after 1 year was 35% greater in communities with elevated CO_2. CO_2 induced stimulation of earthworms which increased soil turnover and N and C cycling.	This data is only required if a concern for the terrestrial compartment is indicated by the risk assessment or if there is likely to be long-term exposure to the active substance. Carbon dioxide is to be used as a fumigant insecticide indoors and vented to atmosphere. There will be no increased carbon dioxide levels in the terrestrial system, so it is not necessary to determine the effect of increased carbon dioxide on earthworms. Notwithstanding this, there is a study available in the public domain, which gives an indication about the possible effects that increased CO_2 may have on cast production by earthworms. This data has been summarised here, for information.. Notwithstanding this, the study summarised here gives an indication about the possible effects that increased CO_2 may have on cast production by earthworms. [1]	Document IIIA Section 7.5.1.2

Footnotes

1. Due to the results available in the core base set of environmental toxicity data for carbon dioxide, particularly that available on the toxicity to earthworms and the fact that there is no exposure to the terrestrial environment, it is not necessary to submit further studies on the effects of carbon dioxide on the reproduction of earthworms or other soil non-target macro-organisms (the data requirements detailed in Document III-A, 7.5.2.1).

Toxicity to terrestrial organisms, initial tests (3 of 5)

Guideline/ Test method	Species	Endpoint / Type of test	Exposure		Results			Remarks	Reference
			Design	Duration	NOEC	LOEC	EC/LC_{50}		
N/A.	Plants	N/A	N/A	N/A	N/A	N/A	N/A	This data is only required if a concern for the terrestrial compartment is indicated by the risk assessment or if there is likely to be long-term exposure to the active substance. Carbon dioxide in this case is used in a closed system, indoors and finally vented to atmosphere. Consequently there will be no increased carbon dioxide levels in the terrestrial system and so it is not necessary to determine the effect of increased carbon dioxide in plants. Notwithstanding this, it should be noted that carbon dioxide plays a vital role in the photosynthesis pathway of plants. It is widely accepted that commercial horticulturists, such as tomato growers, use carbon dioxide to enrich the atmospheres of their greenhouses to accelerate the growth of their crops. [1]	Document IIIA Section 7.5.1.3

Footnotes

1. Due to the results available in the core base set of environmental toxicity data for carbon dioxide, particularly that available on the toxicity to plants and the fact that there is no exposure to the terrestrial environment, it is not necessary to submit further studies on the long term effects of carbon dioxide on plants (the data requirements detailed in Document III-A, 7.5.2.2).

Toxicity to terrestrial organisms, initial tests (4 of 5)

Guideline/ Test method	Species	Endpoint / Type of test	Exposure		Results			Remarks	Reference
			Design	Duration	NOEC	LOEC	EC/LC_{50}		
N/A.	Birds	N/A	N/A	N/A	N/A	N/A	N/A	An acute oral toxicity study for carbon dioxide cannot be submitted because it is not technically possible to determine the acute toxicity of carbon dioxide by the oral route. This is because there is no approved guideline for testing the acute toxicity of a gas by the oral route. It should be noted that carbon dioxide is constantly produced by all birds as a result of the numerous metabolic reactions involving carbon-containing compounds. Broiler chickens in a healthy barn environment can produce up to 60 litres CO_2 /bird/day without causing any toxic effects.	Document IIIA Section 7.5.3.1.1 Document IIIA Section 7.5.3.1.2 Document IIIA Section 7.5.3.1.3
N/A.	Honeybees	N/A	N/A	N/A	N/A	N/A	N/A	It should be noted that carbon dioxide is constantly produced by arthropods as a result of the numerous metabolic reactions involving carbon-containing compounds, without causing any toxic effects.	Document IIIA Section 7.5.4.1
N/A	Other terrestrial non-target organism	N/A	N/A	N/A	N/A	N/A	N/A	This data is only required if a concern for the terrestrial compartment is indicated by the risk assessment or if there is likely to be long-term exposure to the active substance.	Document IIIA Section 7.5.6

Toxicity to terrestrial organisms, initial tests (5 of 5)

Guideline/ Test method	Species	Endpoint / Type of test	Exposure		Results			Remarks	Reference
			Design	Duration	NOEC	LOEC	EC/LC_{50}		
N/A.	Mammals	N/A	N/A	N/A	N/A	N/A	N/A	An acute oral toxicity study for carbon dioxide cannot be submitted because it is not technically possible to determine the acute toxicity of carbon dioxide by the oral route. This is because there is no approved guideline for testing the acute toxicity of a gas by the oral route. Carbon dioxide is used indoors within a sealed fumigation bubble in situations where exposure to mammals will not be expected to occur.	Document IIIA Section 7.5.7.1.1 Document IIIA Section 7.5.7.1.2 Document IIIA Section 7.5.7.1.3

4.2.4 Non compartment specific effects relevant to the food chain (secondary poisoning)

Result
Already submitted for carbon dioxide dossier for Product Type 14. Carbon dioxide does not have any intrinsic properties, which suggest it will bioaccumulate in the environment. In addition, carbon dioxide is not classified as hazardous to health according to EC Directive 67/548/EEC, nor are there any indications of toxicity such as endocrine disruption. The toxicity profile of carbon dioxide, coupled with the fact that it is unlikely to accumulate in the environment, means that there is a low risk of secondary poisoning.

5. HAZARD IDENTIFICATION FOR PHYSICO-CHEMICAL PROPERTIES

a. Thermal stability and identity of relevant breakdown products

Already submitted for carbon dioxide dossier for Product Type 14.

At all pressures, there is a fairly wide range of temperatures in which carbon dioxide disassociates directly into CO and O_2 without precipitation of carbon. Refer to equation below. At higher temperatures C is also formed (in addition to CO and O_2).

$CO_2 \leftrightarrow CO + ½O_2$.

For further details refer to Document III-A3 Section 3.10.

b. Flammability and flash point

Already submitted for carbon dioxide dossier for Product Type 14.

Carbon dioxide is a non-flammable gas which does not support combustion. The flash-point of carbon dioxide cannot be determined because it is a gas at the normal temperatures and pressures which it will be used as a biocide. (Flash point data can only be determined for liquids).
For further details refer to Document III-A3 Section 3.11 and 3.12.

c. Explosive properties

Already submitted for carbon dioxide dossier for Product Type 14.

Carbon dioxide is thermodynamically stable, so does not exhibit explosive properties.
For further details refer to Document III-A3 Section 3.15

d. Oxidising properties

Already submitted for carbon dioxide dossier for Product Type 14.

Oxidising properties of carbon dioxide cannot be determined because it is a gas at the normal temperatures and pressures which it will be used as a biocide. (Oxidising properties can only be determined for solids).
For further details refer to Document III-A3 Section 3.16

e. Reactivity towards container material
Carbon dioxide is supplied in containers designed and manufactured [redacted]
Containers manufactured to this specification will ensure that there is no reactivity between contents and containers.
For further details, refer to Document III-A3 Section 3.17