

SODIUM CARBONATE

This dossier on sodium carbonate presents the most critical studies pertinent to the risk assessment of sodium carbonate in its use in drilling muds and water treatment systems. It does not represent an exhaustive or critical review of all available data. The information presented in this dossier was obtained primarily from the OECD-SIDS documents on sodium carbonate (OECD, 2002a,b) and the ECHA database that provides information on chemicals that have been registered under the EU REACH (ECHA). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch et al., 1997).

Screening Assessment Conclusion – Sodium carbonate is classified as a **tier 1** chemical and requires a hazard assessment only.

1 BACKGROUND

Due to its high water solubility and low vapour pressure, sodium carbonate will be found predominantly in the aquatic environment where it dissociates completely to sodium (Na⁺) and carbonate (CO₃²⁻) ions. Both ions are ubiquitous in the environment. Na⁺ and CO₃²⁻ ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues. Sodium carbonate is of low toxicity concern to aquatic and terrestrial organisms.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): disodium carbonate

CAS RN: 497-19-8

Molecular formula: CH₂O₃.2Na

Molecular weight: 106 g/mol

Synonyms: sodium carbonate; disodium carbonate; carbonic acid, disodium salt; bisodium carbonate; soda ash, calcined soda

3 PHYSICO-CHEMICAL PROPERTIES

Key physical and chemical properties for the substance are shown in Table 1.

Table 1 Overview of the Physico-Chemical Properties of Sodium Carbonate

| Property | Value | Klimisch score | Reference |
|--|--|----------------|-------------|
| Physical state at 20°C and 101.3 kPa | Solid; white powder | 1 | ECHA |
| Melting Point | 851°C @ 101.3 kPa | 2 | ECHA |
| Boiling Point | Decomposes | - | ECHA |
| Density | 2520 kg/m ³ @ 20°C | 1 | ECHA |
| Vapour Pressure | Negligible | - | ECHA |
| Partition Coefficient (log K _{ow}) | Not relevant, ionizable inorganic compound | - | <u>ECHA</u> |
| Water Solubility | 212.5 g/L @ 20°C | 2 | ECHA |

| Property | Value | Klimisch score | Reference |
|-----------------------------|--------------|----------------|-----------|
| Dissociation constant (pKa) | 10.33 @ 20°C | 2 | ECHA |

Aqueous solutions are strongly alkaline. At 25°C, the pH of 1, 5 and 10 wt% sodium carbonate solutions are 11.37, 11.58 and 11.70, respectively (Eggeman, 2001).

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 2). This chemical is listed on the Australian Inventory of Chemical Substances – AICS (Inventory). No conditions for its use were identified. No specific environmental regulatory controls or concerns were identified within Australia and internationally for sodium carbonate.

NICNAS has assessed sodium carbonate in an IMAP Tier 1 assessment and concluded that it poses no unreasonable risk to the environment¹.

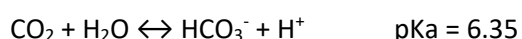
Table 2 Existing International Controls

| Convention, Protocol or other international control | Listed Yes or No? |
|---|-------------------|
| Montreal Protocol | No |
| Synthetic Greenhouse Gases (SGG) | No |
| Rotterdam Convention | No |
| Stockholm Convention | No |
| REACH (Substances of Very High Concern) | No |
| United States Endocrine Disrupter Screening Program | No |
| European Commission Endocrine Disruptors Strategy | No |

5 ENVIRONMENTAL FATE SUMMARY

Due to its high water solubility and negligible vapour pressure, sodium carbonate will be found predominantly in the aquatic environment where it dissociates completely to sodium (Na⁺) and carbonate (CO₃²⁻) ions. Both ions are ubiquitous in the environment (UNEP, 1995).

Addition of sodium carbonate to an aquatic ecosystem will result in an increase in alkalinity and a tendency to increase the pH. The carbonate ions will react with water, forming bicarbonate (HCO₃⁻) and hydroxide (OH⁻) ions until an equilibrium is reached. A re-equilibration takes place when carbonate (CO₃²⁻) is dissolved in water according to the following equations:



¹ <https://www.industrialchemicals.gov.au/chemical-information/search-assessments?assessmentcasnumber=497-19-8>

Only a small fraction of the dissolved CO₂ is present as H₂CO₃ (carbonic acid), the major part is present as CO₂. The amount of CO₂ in water is in equilibrium with the partial pressure of CO₂ in the atmosphere. The CO₂/HCO₃⁻/CO₃²⁻ equilibria are the major buffer of the pH of freshwater.

Based on the above equations, CO₂ is the predominant species at a pH smaller than 6.35, while HCO₃⁻ is the predominant species at a pH in the range of 6.35-10.33 and CO₃²⁻ is the predominant species at a pH higher than 10.33.

A release of sodium carbonate into the aquatic environment from the use of sodium carbonate could potentially increase the sodium concentration and the pH in the aquatic environment. Table 3 shows the concentration of sodium carbonate needed to increase the pH to values of 9.0, 10.0 and 11.0.

Table 3 Sodium Carbonate Concentration (mg/L) Needed to Increase pH (DeGroot et al., 2002; taken from OECD, 2002b)

| Buffer capacity* | Final pH** | | |
|--|------------|-----------|------------|
| | 9.0 | 10.0 | 11.0 |
| 0 mg/L HCO ₃ ⁻ (distilled water) | 11.1 (0.6) | 16 (6.1) | 603 (61) |
| 20 mg/L HCO ₃ ⁻ (10 th percentile of 77 rivers) | 2.7 (21) | 32 (26) | 766 (81) |
| 106 mg/L HCO ₃ ⁻ (mean value of 77 rivers) | 9.7 (107) | 102 (112) | 1467 (167) |
| 195 mg/L HCO ₃ ⁻ (90 th percentile of 77 rivers) | 17 (196) | 175 (201) | 2192 (256) |

*The initial pH of a bicarbonate solution with a concentration of 20-195 mg/L is 8.3 (calculated).

**The final concentration of bicarbonate is given in parentheses.

Na⁺ and CO₃²⁻ ions will not adsorb on particulate matter or surfaces and will not accumulate in living tissues (OECD, 2002b).

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Sodium carbonate is of low toxicity concern to aquatic and terrestrial organisms.

B. Aquatic Toxicity

Acute Studies

The results of the aquatic toxicity studies conducted on sodium carbonate are presented in Table 4.

Table 4 Aquatic Toxicity Studies on Sodium Carbonate (OECD, 2002a,b)

| Test Species | Endpoint | Results (mg/L) | Klimisch score | Reference |
|------------------|--------------------------|----------------|----------------|---------------|
| Bluegill sunfish | 96-hour LC ₅₀ | 300 | 2 | OECD, 2002a,b |

| Test Species | Endpoint | Results (mg/L) | Klimisch score | Reference |
|---------------------------|--------------------------|----------------|----------------|---------------|
| Mosquitofish | 96-hour LC ₅₀ | 740 | 2 | OECD, 2002a,b |
| Bluefill sunfish | 24-hour LC ₅₀ | 385 | 4 | OECD, 2002a,b |
| Molly | 50-hour LC ₅₀ | 297 | 4 | OECD, 2002a,b |
| <i>Ceriodaphnia dubia</i> | 48-hour EC ₅₀ | 200 - 227 | 2 | OECD, 2002a,b |

There are other studies conducted on invertebrates, but the results of these studies were not included in Table 4 because of the low reliability of the data (OECD, 2002a,b). No studies on algae were identified (OECD, 2002a,b).

C. Terrestrial Toxicity

No studies were identified.

7 CATEGORISATION AND OTHER CHARACTERISTICS OF CONCERN

A. PBT Categorisation

The methodology for the Persistent, Bioaccumulative and Toxic (PBT) substances assessment is based on the Australian and EU REACH Criteria methodology (DEWHA, 2009; ECHA, 2008).

Sodium carbonate is an inorganic salt that dissociates completely to sodium and carbonate ions in aqueous solutions. Biodegradation is not applicable to these inorganic ions; both sodium and carbonate ions are also ubiquitous and are present in most water, soil and sediment. For the purposes of this PBT assessment, the persistent criteria are not considered applicable to this inorganic salt.

Sodium and carbonate ions are essential to all living organisms and their intracellular and extracellular concentrations are actively regulated. Thus, sodium carbonate is not expected to bioaccumulate and does not meet the screening criteria for bioaccumulation.

No chronic aquatic toxicity data exist on sodium carbonate; however, the acute EC₅₀ values are >1 mg/L in fish, invertebrates and algae. Therefore, sodium carbonate does not meet the screening criteria for toxicity.

The overall conclusion is that sodium carbonate is not a PBT substance.

B. Other Characteristics of Concern

No other characteristics of concern were identified for sodium carbonate.

8 SCREENING ASSESSMENT

| Chemical Name | CAS No. | Overall PBT Assessment ¹ | Chemical Databases of Concern Assessment Step | | Persistence Assessment Step | | Bioaccumulative Assessment Step | Toxicity Assessment Step | | | Risk Assessment Actions Required ³ |
|------------------|----------|-------------------------------------|---|--------------------------------------|-----------------------------|------------------|---------------------------------|--------------------------|-----------------------------|-------------------------------|---|
| | | | Listed as a COC on relevant databases? | Identified as Polymer of Low Concern | P criteria fulfilled? | Other P Concerns | B criteria fulfilled? | T criteria fulfilled? | Acute Toxicity ² | Chronic Toxicity ² | |
| Sodium carbonate | 497-19-8 | Not a PBT | No | No | NA | No | No | No | 1 | 1 | 1 |

Footnotes:

1 - PBT Assessment based on PBT Framework.

2 - Acute and chronic aquatic toxicity evaluated consistent with assessment criteria (see Framework).

3 - Tier 1 - Hazard Assessment only.

Notes:

NA = not applicable

PBT = Persistent, Bioaccumulative and Toxic

B = bioaccumulative

P = persistent

T = toxic

9 REFERENCES, ABBREVIATIONS AND ACRONYMS

A. References

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B. Abbreviations and Acronyms

| | |
|-------|---|
| °C | degrees Celsius |
| AICS | Australian Inventory of Chemical Substances |
| COC | constituent of concern |
| DEWHA | Department of the Environment, Water, Heritage and the Arts |
| EC | effective concentration |
| ECHA | European Chemicals Agency |
| EU | European Union |
| g | gram |

| | |
|-------------------|--|
| GLP | good laboratory practice |
| g/L | grams per litre |
| IUPAC | International Union of Pure and Applied Chemistry |
| kg/m ³ | kilogram per cubic metre |
| kPa | kilopascal |
| LC | lethal concentration |
| m | metre |
| mg/L | milligram per litre |
| OECD | Organisation for Economic Co-operation and Development |
| PBT | Persistent, Bioaccumulative and Toxic |
| REACH | Registration, Evaluation, Authorisation and Restriction of Chemicals |
| SGG | Synthetic Greenhouse Gases |
| SIDS | Screening Information Data Set |
| wt% | weight percent |