

SODIUM CARBOXYMETHYLCELLULOSE

This dossier on sodium carboxymethylcellulose presents the most critical studies pertinent to the risk assessment of sodium carboxymethylcellulose in its use in drilling muds. It does not represent an exhaustive or critical review of all available data. Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch *et al.*, 1997).

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

1 BACKGROUND

Sodium carboxymethylcellulose (Na CMC) is a white or slightly yellowish powder. It is biodegradable, but not readily biodegradable, and it is not expected to bioaccumulate. Sodium carboxymethylcellulose is a low concern for toxicity to aquatic organisms.

2 CHEMICAL NAME AND IDENTIFICATION

Chemical Name (IUPAC): sodium;2,3,4,5,6-pentahydroxyhexanal;acetate

CAS RN: 9004-32-4

Molecular formula: C₈H₁₅NaO₈

Molecular weight : 262 g/mol (for monosubstituted structural unit); variable 21,000 g/mol – 500,000 g/mol (for macromolecules)

Synonyms: Sodium carboxymethylcellulose, Carboxymethylcellulose, sodium; cellulose, carboxymethyl ether, sodium salt; sodium CMC; sodium cellulose glycolate; sodium CMC; Na CMC

3 PHYSICO-CHEMICAL PROPERTIES

Sodium carboxymethylcellulose is a white or slightly yellowish, almost odourless and tasteless hydroscopic powder, consisting of very fine particles, fine granules or fine fibres (WHO, 1967).

Sodium carboxymethylcellulose, one of major cellulosic ethers, is widely used as a binding, thickening and stabilising agent (Lee et al. 2018).

Pharmaceutical grades of sodium carboxymethylcellulose are available commercially at degree of substitution (DS) values of 0.7, 0.9, and 1.2, with a corresponding sodium content of 6.5%–12% wt. It is also available in several different viscosity grades. Sodium carboxymethylcellulose is highly soluble in water at all temperatures, forming clear solutions. Its solubility depends on its degree of substitution (Düring et al, 2019).

4 DOMESTIC AND INTERNATIONAL REGULATORY INFORMATION

A review of international and national environmental regulatory information was undertaken (Table 1). 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 carboxymethylcellulose.

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

Table 1 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

A. Summary

Sodium carboxymethylcellulose is biodegradable, but is not considered to be readily biodegradable. It is not expected to bioaccumulate.

B. Partitioning

All of the polymers in this group are expected to be water soluble. If discharged into natural waters, sodium carboxymethylcellulose is expected to be present as a polyanion as a result of the ionisation of the carboxymethyl substituents. Comparatively complex partitioning behaviour in aquatic systems may occur based on the well-established interactions between colloids and carboxymethylcellulose, which is a key part of the function of this polymer in laundry detergents (de Oude 1992).

C. Biodegradation

In an OECD 301A test, sodium carboxymethylcellulose (DS 0.7) showed 25% biodegradation after 28 days, followed by a much slower increase of the biodegradation percentage. At day 110, 58% of the theoretical oxygen demand (ThOD) was consumed, leading the investigators to conclude that there was complete degradation of sodium carboxymethylcellulose (VanGinkel and Gayton, 1996). Therefore, sodium carboxymethylcellulose is degradable, but not readily biodegradable. [KI. score = 1]

¹ <https://www.industrialchemicals.gov.au/chemical-information/search-assessments?assessmentcasnumber=9004-32-4>

In an OECD 302A test, only 50% of the carbon from sodium carboxymethylcellulose (DS 0.7) was removed (VanGinkel and Gayton, 1996).

Other studies have also shown partial degradation of sodium carboxymethylcellulose in ready and inherent biodegradability tests (reviewed in VanGinkel and Gayton, 1996). [Kl. score = 4]

If a chemical is found to be inherently or readily biodegradable, it is categorised as Not Persistent since its half-life is substantially less than 60 days (DoEE, 2017).

D. Environmental Distribution

No experimental partition coefficient data are available for sodium carboxymethylcellulose. Based on its high water solubility, the substance is likely to be mobile in the environment.

E. Bioaccumulation

Sodium carboxymethylcellulose is a water-soluble semisynthetic polymer with a high molecular weight (approximately 21,000 to 500,000 daltons). Due to its large molecular weight, it is not expected to bioaccumulate.

6 ENVIRONMENTAL EFFECTS SUMMARY

A. Summary

Sodium carboxymethylcellulose is a low concern for toxicity to aquatic organisms.

B. Aquatic Toxicity

Acute Studies

Table 2 lists the results of acute aquatic toxicity studies conducted on sodium carboxymethylcellulose.

Table 2 Acute Aquatic Toxicity Studies on sodium carboxymethylcellulose or sodium carboxymethylcellulose

Test Species	Endpoint	Results (mg/L)	Klimisch score	Reference
<i>Brachydanio rerio</i>	96-hour LC ₅₀	>2,500*	1	VanGinkel and Gayton (1996)
<i>Daphnia magna</i>	48-hour EC ₅₀	>5,000*	1	VanGinkel and Gayton (1996)
<i>Daphnia magna</i>	48-hour EC ₅₀	87.26**	2	Warne and Schifko (1999)
<i>Selenastrum capricornutum</i>	96-hour EC ₅₀	500*	1	VanGinkel and Gayton (1996)

*sodium carboxymethylcellulose (0.7) was tested.

** sodium carboxymethylcellulose was tested.

Additional aquatic toxicity studies on sodium carboxymethylcellulose by Schöberl *et al.* (1988) reported LC₀ values of >250 to 1,000 mg/L for fish and >1,000 mg/L for *Daphnia*.

VanGinkel and Gayton (1996) also tested the degradation products of sodium carboxymethylcellulose from *Agrobacterium* CM-1 in acute toxicity studies. There was no toxicity to

Brachydanio rerio (1,000 mg/L), *Daphnia magna* (1,000 mg/L) or *Selenastrum capricornutum* (500 mg/L).

It is unclear why there is a large difference in *Daphnia* EC₅₀ values between the studies of VanGinkel and Gayton (1996) and Warne and Schifko (1999). One possibility is that the two laboratories may have tested different sodium carboxymethylcellulose products. VanGinkel and Gayton (1996) tested sodium carboxymethylcellulose (0.7), whereas Warne and Schifko (1999) tested sodium carboxymethylcellulose (with no further description) in their study. However, the studies by Schöberl et al. (1988) reported an acute toxicity for *Daphnia* that is similar to that reported by VanGinkel and Gayton (1996). As a water-soluble polymer, sodium carboxymethylcellulose or sodium carboxymethylcellulose would be expected to exhibit low toxicity due to its large molecular weight and its inert characteristics.

Chronic Studies

No additional studies were identified. However, VanGinkel and Gayton (1996) reported that there was no toxicity to *Daphnia* in a 21-day reproduction test when tested using effluent from sodium carboxymethylcellulose treated with in a conventional activated sludge system (CAS system), (*i.e.*, no toxicity due to partial degradation of sodium carboxymethylcellulose).

C. Terrestrial Toxicity

No studies are available.

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 carboxymethylcellulose is a water-soluble semisynthetic polymer that is not readily biodegradable. Therefore, it meets the screening criteria for persistence.

Sodium carboxymethylcellulose is a water-soluble semisynthetic polymer that has a high molecular weight (approximately 21,000 to 500,000 daltons) which limits its bioavailability to aquatic organisms. Therefore, it is not expected to bioaccumulate and does not meet the screening criteria for bioaccumulation.

The acute EC₅₀ of sodium carboxymethylcellulose is >1 mg/L in fish, invertebrates and algae. Therefore, it does not meet the screening criteria for toxicity.

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

B. Other Characteristics of Concern

No other characteristics of concern were identified for sodium carboxymethylcellulose.

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 Carboxymethylcellulose	9004-32-4	Not a PBT	No	No	Yes	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

AICS Australian Inventory of Chemical Substances

CAS system conventional activated sludge system

CMC	carboxymethylcellulose
COC	constituent of concern
DEWHA	Department of the Environment, Water, Heritage and the Arts
DS	degree of substitution
EC	effective concentration
ECHA	European Chemicals Agency
EU	European Union
IUPAC	International Union of Pure and Applied Chemistry
KI	Klimisch scoring system
LC	lethal concentration
mg/L	milligrams 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
ThOD	theoretical oxygen demand
WHO	World Health Organization