

## SODIUM POLYACRYLATE

This dossier on sodium polyacrylate presents the most critical studies pertinent to the risk assessment of sodium polyacrylate in its use in coal seam gas extraction activities. It does not represent an exhaustive or critical review of all available data. The majority of information presented in this dossier was obtained from the HERA document on polyacrylic acid homopolymers and their sodium salts (CAS RN 9003-04-7) (HERA, 2014). Where possible, study quality was evaluated using the Klimisch scoring system (Klimisch et al., 1997).

Screening Assessment Conclusion – Sodium polyacrylate is a polymer of low concern. Therefore, it is classified as a **tier 1** chemical and requires a hazard assessment only.

### 1 BACKGROUND

Sodium polyacrylate are a group of polymers that range in molecular weight from 1,000 to 78,000 g/mol. The sodium polyacrylates mostly used in detergents have a typical molecular weight of approximately 4,500 g/mol (HERA, 2014). These polymers are not readily biodegradable but are partly accessible to ultimate biodegradation. They are not expected to bioaccumulate. Sodium polyacrylate exhibits a low toxicity concern for aquatic organisms, terrestrial invertebrates and plants.

### 2 CHEMICAL NAME AND IDENTIFICATION

**Chemical Name (IUPAC):** 1-Propenoic acid, homopolymer, sodium salt

**CAS RN:** 9003-04-7

**Molecular formula:** (C<sub>3</sub>H<sub>4</sub>O<sub>2</sub>)<sub>x</sub>·x·Na

**Molecular weight:** Variable

**Synonyms:** 2-Propenoic acid, homopolymer, sodium salt; polyacrylic acid, sodium salt, sodium polyacrylate; acrylic acid, polymers, sodium salt; poly(acrylic acid), sodium salt; polyacrylate sodium salt

### 3 PHYSICO-CHEMICAL PROPERTIES

Sodium polyacrylates are polymers that range in molecular weight (MW) from 1,000 to 78,000 g/mol (HERA, 2014). The sodium polyacrylates mostly used in detergents have a typical molecular weight of approximately 4,500 g/mol (HERA, 2014). For sodium polyacrylate (MW 4,500), the melting point is >150°C, where it decomposes; and the water solubility is >400 g/L (HERA, 2014).

### 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 polyacrylate.

NICNAS has assessed sodium polyacrylate in an Inventory Multi-tiered Assessment and Prioritisation (IMAP) Tier 1 assessment and considers it a polymer of low concern.<sup>1</sup>

**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 polyacrylates are not readily biodegradable. Due to their high molecular weights, sodium polyacrylates are not expected to bioaccumulate. In addition, these water-soluble polymers can form insoluble calcium salts in natural waters, suggesting that bioaccumulation is unlikely.

### B. Partitioning

Abiotic degradation mechanisms like photolytic and hydrolytic processes do not significantly influence the environmental fate of sodium polyacrylates (HERA, 2014).

### C. Biodegradation

Sodium polyacrylates are not readily biodegradable but are partly accessible to ultimate biodegradation, particularly under long incubation conditions. Sodium polyacrylates with MW of <2,000 g/mol are partly biodegradable under the conditions of soil and sediment inoculation. Test results with activated sludge inoculum indicate different elimination degrees, apparently due to adsorption and precipitation processes. The removal degrees of different sodium polyacrylates show no clear relationship between elimination extent and molecular weight (HERA, 2014).

### D. Environmental Distribution

Adsorption onto solids and precipitation are the principal mechanisms of abiotic elimination for this type of polymer, the degree of elimination differs and is strongly influenced by test concentration and water hardness (HERA, 2014).

### E. Bioaccumulation

No experimental studies are available on sodium polyacrylates. Estimated bioconcentration factors based on octanol-water coefficients are not appropriate since the molecular weights of these polymers are higher than the molecular weight range for the QSAR models. Due to their high

<sup>1</sup> <https://www.industrialchemicals.gov.au/help-and-guides/polymer-low-concern-plc-criteria>

molecular weights, sodium polyacrylates are not expected to bioaccumulate. In addition, these water-soluble polymers can form insoluble calcium salts in natural waters, suggesting that bioaccumulation is unlikely (HERA, 2014).

## 6 ENVIRONMENTAL EFFECTS SUMMARY

### A. Summary

Sodium polyacrylates are of low toxicity concern for aquatic organisms, terrestrial invertebrates and plants.

### B. Aquatic Toxicity

#### Acute Studies

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

**Table 2 Acute Aquatic Toxicity Studies on Sodium Polyacrylates**

| Mean MW | Test Species                     | Endpoint                 | Results (mg/L) | Klimisch score | Reference  |
|---------|----------------------------------|--------------------------|----------------|----------------|------------|
| 1,000   | <i>Brachydanio rerio</i>         | 96-hour LC <sub>50</sub> | >200           | 1              | HERA, 2014 |
| 1,000   | <i>Salmo gairdneri</i>           | 96-hour LC <sub>50</sub> | >1,000         | 1              | HERA, 2014 |
| 1,200   | <i>Leuciscus idus</i>            | 96-hour LC <sub>50</sub> | >500           | 1              | HERA, 2014 |
| 2,000   | <i>Brachydanio rerio</i>         | 96-hour LC <sub>50</sub> | >200           | 1              | HERA, 2014 |
| 2,500   | <i>Leuciscus idus</i>            | 96-hour LC <sub>50</sub> | >500           | 1              | HERA, 2014 |
| 4,500   | <i>Lepomis macrochirus</i>       | 96-hour LC <sub>50</sub> | >1,000         | 1              | HERA, 2014 |
| 4,500   | <i>Lepomis macrochirus</i>       | 96-hour LC <sub>50</sub> | >1,000         | 1              | HERA, 2014 |
| 8,000   | <i>Leuciscus idus</i>            | 96-hour LC <sub>50</sub> | >500           | 1              | HERA, 2014 |
| 10,000  | <i>Lepomis macrochirus</i>       | 96-hour LC <sub>50</sub> | >1,000         | 1              | HERA, 2014 |
| 15,000  | <i>Leuciscus idus</i>            | 96-hour LC <sub>50</sub> | >10,000        | 1              | HERA, 2014 |
| 78,000  | <i>Brachydanio rerio</i>         | 96-hour LC <sub>50</sub> | >400           | 2              | HERA, 2014 |
| 1,000   | <i>Daphnia magna</i>             | 48-hour EC <sub>50</sub> | >200           | 1              | HERA, 2014 |
| 1,000   | <i>Daphnia magna</i>             | 48-hour EC <sub>50</sub> | >1,000         | 1              | HERA, 2014 |
| 2,000   | <i>Daphnia magna</i>             | 48-hour EC <sub>50</sub> | >200           | 1              | HERA, 2014 |
| 4,500   | <i>Daphnia magna</i>             | 48-hour EC <sub>50</sub> | >200           | 1              | HERA, 2014 |
| 4,500   | <i>Daphnia magna</i>             | 48-hour EC <sub>50</sub> | >1,000         | 1              | HERA, 2014 |
| 78,000  | <i>Daphnia magna</i>             | 24-hour EC <sub>50</sub> | 276            | 2              | HERA, 2014 |
| 8,000   | <i>Selenastrum capricornutum</i> | 72-hour EC <sub>50</sub> | 40             | 1              | HERA, 2014 |
| 78,000  | <i>Scenedesmus subspicatus</i>   | 96-hour EC <sub>50</sub> | 44             | 2              | HERA, 2014 |

## Chronic Studies

Table 3 lists the results of chronic aquatic toxicity studies on sodium polyacrylates.

**Table 3 Chronic Aquatic Toxicity Studies on Sodium Polyacrylates (HERA, 2014)**

| Mean MW | Test Species                   | Endpoint     | Results (mg/L) | Klimisch score | Reference  |
|---------|--------------------------------|--------------|----------------|----------------|------------|
| 4,500   | <i>Pimephales promelas</i>     | 32-day NOEC  | 56             | 2              | HERA, 2014 |
| 4,500   | <i>Brachydanio rerio</i>       | 28-day NOEC  | >450           | 1              | HERA, 2014 |
| 78,000  | <i>Brachydanio rerio</i>       | 14-day NOEC  | >400           | 2              | HERA, 2014 |
| 4,500   | <i>Daphnia magna</i>           | 21-day NOEC  | 450            | 1              | HERA, 2014 |
| 4,500   | <i>Daphnia magna</i>           | 21-day NOEC  | 58             | 1              | HERA, 2014 |
| 4,500   | <i>Daphnia magna</i>           | 21-day NOEC  | 12             | 2              | HERA, 2014 |
| 78,000  | <i>Daphnia magna</i>           | 21-day NOEC  | 100            | 2              | HERA, 2014 |
| 4,500   | <i>Scenedesmus subspicatus</i> | 96-hour NOEC | 180            | 2              | HERA, 2014 |
| 78,000  | <i>Scenedesmus subspicatus</i> | 96-hour NOEC | 32.8           | 2              | HERA, 2014 |

There is considerable variability in the chronic aquatic toxicity results for *Daphnia magna* for sodium polyacrylates with the same molecular weight of 4,500. This was explained by the solubility of sodium polyacrylates in water (HERA, 2014). In distilled water, the solubility of sodium polyacrylates with the molecular weight of 4,500 is >400 mg/L; however, under test conditions, water solubility will decrease due to the presence of Ca<sup>++</sup> and Mg<sup>++</sup> (as measured by water hardness). In a study by BASF (reviewed in HERA, 2014), the water solubility of sodium polyacrylate (MW 4,500) was determined with radiolabelled compounds in a test system with a calcium concentration of 70 mg/L. This corresponds to the mean water hardness to the media used in an OECD TG 202 test. Under these conditions, the water solubility of sodium polyacrylate was 1.3 mg/L after 24 hours. So, one explanation for the variability of the chronic *Daphnia* studies may be due to differences in water hardness.

### C. Toxicity to Sediment Organisms

The 96-hour EC<sub>0</sub> to *Chironomus riparius* (larvae) is >4,500 mg/kg sediment dry weight (HERA, 2014).

### D. Terrestrial Toxicity

The results of terrestrial toxicity studies on sodium polyacrylate polymers are listed in Table 4.

**Table 4 Terrestrial Toxicity Studies on Sodium Polyacrylates (HERA, 2014)**

| Mean MW | Test Species                   | Endpoint               | Results (mg/L) | Klimisch Score | Reference  |
|---------|--------------------------------|------------------------|----------------|----------------|------------|
| 4,500   | <i>Eisenia foetida foetida</i> | 14-day EC <sub>0</sub> | 1,000          | 1              | HERA, 2014 |
| 78,000  | <i>Eisenia foetida andrei</i>  | 14-day EC <sub>0</sub> | 1,000          | 2              | HERA, 2014 |
| 78,000  | <i>Brassica rapa</i>           | 21-day NOEC            | 1,000          | 2              | HERA, 2014 |

| Mean MW | Test Species             | Endpoint                | Results (mg/L) | Klimisch Score | Reference  |
|---------|--------------------------|-------------------------|----------------|----------------|------------|
| 4,500   | Nitrogen transformation* | 28-day EC <sub>10</sub> | >2,500         | 1              | HERA, 2014 |
| 4,500   | Carbon transformation*   | 28-day EC <sub>10</sub> | >2,500         | 1              | HERA, 2014 |

\*Soil organisms

## 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 (IChEMS, 2022; ECHA, 2023).

The sodium polyacrylates are not readily biodegradable; thus, they meet the screening criteria for persistence.

The sodium polyacrylates are expected to have high molecular weights and are not expected to be bioavailable. Thus, these polymers do not meet the criteria for bioaccumulation.

Chronic NOECs for fish, daphnia and algae are available for sodium polyacrylates, and the NOEC values are >0.1 mg/L. Thus, sodium polyacrylates do not meet the screening criteria for toxicity.

The overall conclusion is that sodium polyacrylates are not PBT substances.

### B. Other Characteristics of Concern

No other characteristics of concern were identified for sodium polyacrylate.

8 SCREENING ASSESSMENT

| Chemical Name       | CAS No.   | Overall PBT Assessment <sup>1</sup> | Chemical Databases of Concern Assessment Step |                                      | Persistence Assessment Step |                  | Bioaccumulative Assessment Step | Toxicity Assessment Step |                             |                               | Risk Assessment Actions Required <sup>3</sup> |
|---------------------|-----------|-------------------------------------|-----------------------------------------------|--------------------------------------|-----------------------------|------------------|---------------------------------|--------------------------|-----------------------------|-------------------------------|-----------------------------------------------|
|                     |           |                                     | 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 <sup>2</sup> | Chronic Toxicity <sup>2</sup> |                                               |
| Sodium Polyacrylate | 9003-04-7 | Not a PBT                           | No                                            | Yes                                  | 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:**  
PBT = Persistent, Bioaccumulative and Toxic  
B = bioaccumulative  
P = persistent  
T = toxic

## 9 REFERENCES, ABBREVIATIONS AND ACRONYMS

### A. References

- European Chemicals Agency [ECHA]. (2023). Chapter R.11: vPvB assessment. In *Guidance on information requirements and chemical safety assessment*. Version 4.0.  
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### B. Abbreviations and Acronyms

|        |                                                                         |
|--------|-------------------------------------------------------------------------|
| °C     | degrees Celsius                                                         |
| AICS   | Australian Inventory of Chemical Substances                             |
| CAS RN | Chemical Abstract Services Registry Number                              |
| COC    | constituent of concern                                                  |
| EC     | effective concentration                                                 |
| ECHA   | European Chemicals Agency                                               |
| EU     | European Union                                                          |
| g/L    | grams per litre                                                         |
| GHS    | Globally Harmonised System of Classification and Labelling of Chemicals |
| IChEMS | Industrial Chemicals Environmental Management Standard                  |
| IMAP   | Inventory Multitiered Assessment and Prioritisation                     |
| IUPAC  | International Union of Pure and Applied Chemistry                       |
| LC     | lethal concentration                                                    |
| mg/kg  | milligrams per kilogram                                                 |
| mg/L   | milligrams per litre                                                    |
| MW     | molecular weight                                                        |
| NICNAS | National Industrial Chemicals Notification and Assessment Scheme        |
| NOEC   | no observed effective concentration                                     |
| OECD   | Organisation for Economic Co-operation and Development                  |
| PBT    | Persistent, Bioaccumulative and Toxic                                   |
| QSAR   | quantitative structure activity relationship                            |
| REACH  | Registration, Evaluation, Authorisation and Restriction of Chemicals    |

SGG  
TG

Synthetic Greenhouse Gases  
Test Guideline