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# Response to Public Comments for Sodium aluminate (CAS #1302-42-7)

## Summary:

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD), received comments for sodium aluminate on May 16, 2019. Based on public comments, the AQD reviewed the derivation of the Initial Threshold Screening Level (ITSL) for sodium aluminate. Based on that review, the AQD agrees with the commenter that the sodium aluminate ITSL of 0.1 µg/m$^3$ (annual averaging time), which was determined using Rule 232(1)(i), is not appropriate and defensible to protect public health from sodium aluminate's acute irritating effects to the lungs. Even though sodium hydroxide is also a highly corrosive chemical, it is not appropriate to use the sodium hydroxide ITSL to derive an ITSL for sodium aluminate. As there is no chemical specific toxicity data to support a more appropriate and defensible ITSL for sodium aluminate, the ITSL of 0.1 µg/m$^3$ (annual averaging time) is being rescinded. Sodium aluminate will be evaluated on a case-by-case basis until chemical specific toxicity information is available to derive a screening level.

## Background:

Revisions to the Air Pollution Control Rules[1] were promulgated December 22, 2016. Subsequently, EGLE, AQD published toxic air contaminant screening levels and their basis as required by Rule 230(1). Pursuant to Rule 230(2), the AQD solicited and received public comments on a set of newly derived screening levels for 30 days: May 15, 2019 through June 17, 2019. Sodium aluminate was included in the list of

[1] Air Pollution Control Rules in Michigan Administrative Code promulgated pursuant to Article II Pollution Control, Part 55 (Sections 324.5501-324.5542), Air Pollution Control, of the Natural Resources And Environmental Protection Act, 1994, PA 451, as amended (NREPA).

chemicals open for public comment. The AQD is required to respond to these comments within 60 days; the latest date for response is August 16, 2019.

**Comments and Responses:**

**Comment:**

The commenter provided comments on the sodium aluminate (CAS #1302-42-7) Initial Threshold Screening Level (ITSL), which is set at 0.1 µg/m$^3$ with an annual averaging time. The commenter requested that the ITSL be set at 16.4 µg/m$^3$ with a 1-hour averaging time. The commenter pointed out that sodium aluminate is a highly corrosive material that reacts with water to form aluminum hydroxide and sodium hydroxide. The commenter stated that the corrosive nature of sodium aluminate is due to its formation of sodium hydroxide. The commenter referenced the following chemical reaction: $AlO_2Na + 2H_2O \rightarrow Al(OH)_3 + NaOH$. The commenter referenced the sodium hydroxide ITSL of 8 µg/m$^3$ (1-hour averaging time) claiming that it should be used to protect against "mild adverse effects". The commenter used a molar ratio and the ratio of molecular weights (sodium hydroxide 40 g/mol and sodium aluminate 82 g/mol) for a suggested ITSL of 16.4 µg/m$^3$ (1-hour averaging time). The commenter listed one reference:

1. http://allreactions.com/index.php/group-3a/aluminium/sodium-aluminate

**Response:**

The AQD's Toxics Unit staff have reviewed the basis for the initial threshold screening level (ITSL) for sodium aluminate (CAS #1302-42-7), which was set December 27, 2018, at 0.1 µg/m$^3$ (annual averaging time). The ITSL was based on Rule 232(1)(i) due to the lack of any available chemical specific toxicological studies.

The commenter suggested that the ITSL may be based on sodium hydroxide as both chemicals (NaOH and $AlO_2Na$) are highly corrosive materials. The commenter is correct that sodium aluminate is a highly corrosive material. Both sodium hydroxide and sodium aluminate are soluble in water and induce highly basic pHs. As to the chemical reaction above, sodium aluminate does not readily form sodium hydroxide (a more detailed explanation is available in Appendix A). Screening levels can be determined from a readily formed product of a highly reactive chemical, which would not be expected to be found in an air emission in its original form. Screening levels can also be determined from a structurally similar chemical that has more toxicity information associated with it. An example of this is the ethylene glycol dimethyl ether screening level, which was derived from the structurally similar chemical ethylene glycol monomethyl ether. Sodium hydroxide is not readily formed from sodium aluminate nor is sodium hydroxide structurally similar to sodium aluminate. Therefore, the sodium hydroxide screening level cannot be used for sodium aluminate.

The commenter is correct that sodium aluminate is a highly corrosive material and that the screening level of 0.1 µg/m$^3$ (annual averaging time) would not be protective of acute irritant effects. As no chemical specific toxicity information is available, the screening level for sodium aluminate is rescinded. Sodium aluminate will be evaluated on a case by case basis until chemical specific toxicity information is available from which to derive a screening level.

**Summary and Conclusions:**

In summary, the ITSL for sodium aluminate of 0.1 µg/m$^3$ is rescinded. Sodium aluminate emissions will be evaluated on a case by case basis.

The primary AQD reviewer for these comments was Doreen Lehner, Toxicologist, Toxics Unit. The secondary (peer) reviewer was Keisha Williams, Senior Toxicologist, Toxics Unit.

**References:**

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## APPENDIX A

The commenter suggested that the ITSL may be based on sodium hydroxide as both chemicals (NaOH and $AlO_2Na$) are highly corrosive materials. The AQD agrees that sodium aluminate is highly corrosive. The reaction the commenter supplied is not entirely accurate. The chemical reaction given in allreactions.com (2019) under sodium aluminate shows the following equation: $NaAlO_2 + 2H_2O(hot) \dashrightarrow time \dashrightarrow NaOH + Al(OH)_3$ (amorphous). Sodium aluminate does not readily form sodium hydroxide. It requires heat and time for this reaction to occur. When searching sodium hydroxide in allreactions.com the methods for obtaining sodium hydroxide do not include sodium aluminate. Sodium aluminate is only found in the subgroup labeled "Reactions with sodium hydroxide NaOH." There the reaction states that the temperature needed to drive the reaction is 1000°C. As sodium aluminate does not readily form sodium hydroxide under ambient conditions, the sodium hydroxide ITSL would not be an appropriate value for sodium aluminate based on this equation.

The chemical properties of sodium aluminate and sodium hydroxide are listed in table 1.

**Table 1**. Chemical and physical properties of sodium aluminate and sodium hydroxide.

| Chemical or Physical Property | Sodium aluminate | Sodium hydroxide |
|---|---|---|
| Molecular weight[a] | 81.9701 | 39.9971 |
| LogP: Octanol-Water[f] | -0.670 | -1.38 |
| Melting point[f] | 328 °C | 318 °C |
| Boiling point | 746 °C[f] | 1,388 °C[b] |
| Water solubility | 5.92 mol/L[f] | 1000 g/L (25°C)[c] |
| Vapor pressure[b] | Data unavailable | $1.82 \times 10^{-21}$ mmHg at 25°C (extrapolated) |
| Density[b] | 1.5 g/cm$^3$ | 2.13 g/cm$^3$ at 25°C |
| Physical state at standard temperature and pressure[b] | White hygroscopic powder | White solid |
| Odor | Odorless[c] | Odorless[b] |
| Acid dissociation constant (pKa) | Data unavailable | 13.8[d] |
| Base dissociation constant (pKb)[c] | Data unavailable | -0.56 ($NaOH (aq) = Na^+ + OH^-$) |
| pH | 11.5[e] | 14[d] |

a) NIST Chemistry WebBook (2019)
b) PubChem (2019)
c) Wikipedia (2019)
d) Reference (2019)
e) ECHA (2019)
f) EPA (2019)

Sodium hydroxide readily absorbs moisture and carbon dioxide from the air. Sodium hydroxide also reacts with acidic oxides, such as sulfur dioxide, to “scrub” these acidic gases produced in burning coal. This prevents acidic gas release into the atmosphere. Sodium aluminate also readily absorbs moisture from the air.

Sodium hydroxide is not used as a flocculant (a settling agent). Sodium aluminate is used as a flocculant to help in the removal of contaminants in wastewater treatment applications. The intrinsic properties of sodium aluminate, volatility, dispersion rates, heat of reaction, etc. with regards to sodium hydroxide have not been studied. Therefore, it is inappropriate to relate the properties of sodium aluminate to sodium hydroxide without further studies.

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