

# MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

## INTEROFFICE COMMUNICATION

TO: File for Monoammonium Phosphate (CAS No. 7722-76-1)

FROM: Michael Depa, Toxicologist, Air Quality Division

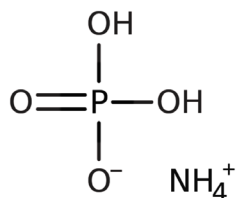
SUBJECT: Screening Level Derivation

DATE: October 31, 2024

In lieu of setting an Initial Threshold Screening Level (ITSL) for monoammonium phosphate (MAP), use the National Ambient Air Quality Standard (NAAQS) for Particulate Matter (PM) to evaluate emissions and impacts. See footnote No. 26 of the [Toxics Screening Level Query Notes](#).

A literature review was conducted to find toxicity data for MAP. The following references and databases were searched: European Chemical Agency (ECHA) Registration, Evaluation, Authorisation *[sic]* and Restriction of Chemicals (REACH), United States Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS), National Institute for Occupational Safety and Health (NIOSH®), American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Values and Biological Exposure Indices (TLV/BEI) 2022 Guide, National Toxicology Program (NTP) Study Database, International Agency for Research on Cancer (IARC), Registry of Toxic Effects of Chemical Substances (RTECS®), Chemical Abstract Service (CAS) SciFinder®, PubMed®, EPA Computational Toxicology (CompTox) Database, EPA Provisional Peer-Reviewed Toxicity Values (PPRTVs), National Technical Information Service (NTIS), Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Level (MRL) database, and California Office of Environmental Health Hazard Assessment (OEHHA). NIOSH, ACGIH, EPA, ATSDR, and OEHHA have not derived health benchmarks for MAP. MAP has a molecular formula of H<sub>6</sub>NO<sub>4</sub>P, and a molecular weight of 132.056 g/mol.

### Molecular Structure of Monoammonium Phosphate (MAP)



## Background Information on MAP

### Excerpts from USEPA (2021)

MAP and DAP [diammonium phosphate] are used as fertilizers and plant nutrients, flame retardants, in fire-extinguishers and fire-proofing agents, oral care agents, in cosmetics as buffering agents and corrosion inhibitors, and in fermentations for yeast cultures.

Fire extinguishers contain large, varying amounts of MAP in powder form (34–40% in some reports). Intentional inhalation and/or ingestion of fire extinguishing powder (during suicide attempts) has reportedly caused electrolyte imbalance and metabolic acidosis in numerous case studies [Becker et al. (2018) (published in German with English abstract), Doyon and McGrath (2003) (abstract only), Lee et al. (2016), Lin et al. (2009), Senthilkumaran et al. (2012)]. MAP doses were not estimated for these cases; however, serum phosphate levels in the patients were reported, ranging between 9.8 and 30.6 mg/dL (normal range is 2.3–4.5 mg/dL) [Doyon and McGrath (2003) (abstract only), Lee et al. (2016), Lin et al. (2009), Senthilkumaran et al. (2012)]. Effects reported in the patients included respiratory tract irritation, hyperphosphatemia, hypocalcemia, metabolic acidosis, delayed aspiration pneumonia, acute kidney failure, and cardiac arrest.

### Exposure Limits for MAP Derived from Unknown Toxicological Data

- Military Exposure Guideline (MEG) Negligible: 30 mg/m<sup>3</sup> (TEEL-1) (CompTox, 2024)
- Protective Action Criteria (PAC) PAC1: 20 mg/m<sup>3</sup> (CompTox, 2024)
- Occupational Exposure Limit (Russia) Short-term exposure limit: 10 mg/m<sup>3</sup> (RTECS, 2024)

## Discussion

No inhalation toxicity data was available for MAP. Toxicity of MAP can be inferred from diammonium phosphate (DAP) because of the similarity of structure and physiological effects.

Monoammonium Phosphate (MAP)	Diammonium Phosphate (DAP)
CAS No. 7722-76-1	CAS No. 7783-28-0
Molecular Formula: H <sub>6</sub> NO <sub>4</sub> P Average Mass: 115.025 g/mol	Molecular Formula: H <sub>9</sub> N <sub>2</sub> O <sub>4</sub> P Average Mass: 132.056 g/mol
$\begin{array}{c} \text{OH} \\   \\ \text{O}=\text{P}-\text{OH} \\   \\ \text{O}^- \quad \text{NH}_4^+ \end{array}$	$\begin{array}{c} \text{O}^- \quad \text{NH}_4^+ \\   \\ \text{O}=\text{P}-\text{OH} \\   \\ \text{O}^- \quad \text{NH}_4^+ \end{array}$

USEPA (2021) states, “The screening subchronic p-RfD for DAP is expected to be protective for monoammonium phosphate (MAP).” However, using oral data to derive an inhalation health-based screening level is not appropriate because of portal-of-entry effects in the lungs, which are likely caused by the ammonium ion.

USEPA (2021) states that:

Because the determinant of the local toxicity (irritation) of DAP and MAP is expected to be the ammonium ion, the toxicity of these compounds is directly related to the relative molecular weight contribution from ammonium.

DAP inhalation toxicity data was evaluated to derive an ITSL (EGLE, 2024). DAP produced no death in Wistar rats exposed to 5000 mg/m<sup>3</sup> for 4 hours (ECHA, 2024). Macroscopic post-mortem examination showed no effects of DAP in the respiratory tract. EGLE (2024) decided that the most appropriate method of evaluating inhalation toxicity of DAP was to apply the National Ambient Air Quality Standard (NAAQS) for particulate matter (PM). Since DAP and MAP are similar in structure and are expected to have the same toxic effects, and no significant effects are anticipated at or below the PM NAAQS standard, it was deemed appropriate to use the NAAQS for PM to evaluate ambient air impacts of MAP using the NAAQS for PM. The following footnote is applied to MAP:

26. This toxic air contaminant (TAC) is reasonably anticipated to exist as a particle in the ambient air. A toxicological review has determined that, in lieu of setting a screening level, the primary NAAQS for particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub>) are reasonable and appropriate health protective levels for the particulate. The combined ambient impact of all particulate TAC emissions from the process must be below the applicable PM primary NAAQS (PM<sub>2.5</sub>, PM<sub>10</sub>). The PM primary NAAQS for particulate matter may be used in permit to install exemption determinations for this TAC under Rule 290(2)(a)(iii) or Rule 291.

## References

Becker, TS; Schuhmacher, G; Stich, R; Eyer, F; Knuefermann, P. (2018). [Life-threatening metabolic acidosis after ingestion of fire extinguisher powder]. *Anaesthesist* 67: 674-678. <http://dx.doi.org/10.1007/s00101-018-0477-7>

CompTox, Computational Toxicology (online database). 2024. Ammonium phosphate. 7722-76-1 | DTXSID5029689. CompTox Chemicals Dashboard. Accessed September 24, 2024  
<https://comptox.epa.gov/dashboard/chemical/details/DTXSID5029689>

Doyon, S; McGrath, JM. (2003). Hyperphosphatemia and cardiac arrest following inhalation of a dry chemical fire extinguisher [Abstract]. *J Toxicol Clin Toxicol* 41: 609-640.

ECHA, European Chemical Agency. (2024). Dossier for Diammonium hydrogenorthophosphate. European Chemical Agency. Accessed 21 March, 2024.  
<https://www.echa.europa.eu/web/guest/registration-dossier/-/registered-dossier/15555>

EGLE, Michigan Department of Environment, Great Lakes, and Energy (2024). File for Diammonium Phosphate (CAS No. 7783-28-0) (Interoffice Communication). Subject: Screening Level Derivation. From: Michael Depa, Toxicologist, Air Quality Division. July 30, 2024. Accessed On-line Sept 23, 2024.

[https://www.egle.state.mi.us/aps/downloads/ATSL/7783-28-0/7783-28-0\\_PM\\_NAAQS.pdf](https://www.egle.state.mi.us/aps/downloads/ATSL/7783-28-0/7783-28-0_PM_NAAQS.pdf)

Lee, DH; Choi, YH; Lee, DH. (2016). Delayed aspiration pneumonia and systemic toxicity in patient who inhaled dry powder of fire extinguisher. Hong Kong Journal of Emergency Medicine 23: 234-237. <http://dx.doi.org/10.1177/102490791602300405>

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Senthilkumaran, S; Meenakshisundaram, R; Balamurgan, N; SathyaPrabhu, K; Karthikeyan, V; Thirumalaikolundusubramanian, P. (2012). Fire extinguisher: an imminent threat or an eminent danger? Am J Emerg Med 30: 515.e513-515.e515.

<http://dx.doi.org/10.1016/j.ajem.2011.01.018>

USEPA, United States Environmental Protection Agency. (2021). Provisional Peer-Reviewed Toxicity Values for Ammonium Salts of Inorganic Phosphates: Monoammonium Phosphate (MAP) (CASRN 7722-76-1) Diammonium Phosphate (DAP) (CASRN 7783-28-0). EPA/690/R-21/007F. September 2021. FINAL. Accessed September 16, 2024.

[https://www.ncbi.nlm.nih.gov/books/NBK584913/pdf/Bookshelf\\_NBK584913.pdf](https://www.ncbi.nlm.nih.gov/books/NBK584913/pdf/Bookshelf_NBK584913.pdf)

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