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NDMA and other Nitrosamines

The NDMA Experts

- Responsible Party Identification
- GIS and Geomatics
- Contaminant Hydrogeology
- Fate and Transport Modeling
- Risk Assessment
- Remediation Feasibility Studies
- Soil and Groundwater Remediation
- Natural Resource Damage Assessment
- Water Resources Assessment
- Source Water Assessment and Protection
- Drinking Water Treatment
- Environmental Risk Management
- Litigation Support/Expert Witness
- Forensic Engineering
- Stakeholder/Public Participation
- Regulatory Strategy



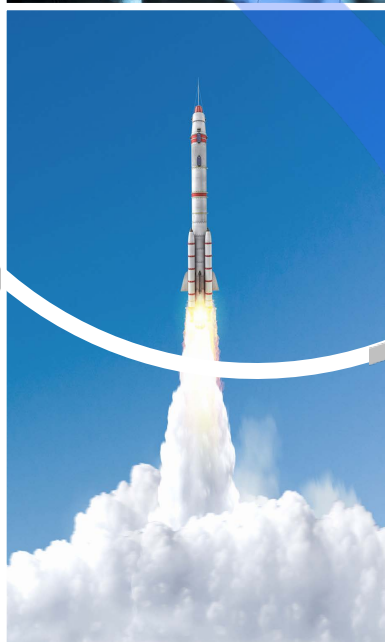
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NDMA Properties^{1,2}

Molecular Weight	Density	Solubility	Henry's Law Constant K_h	Octanol-Water Partition Coefficient (log K_{ow})	log K_{oc}
g/mol	g/cm ³ at 25°C	mg/L at 20-25°C	unitless	unitless	unitless
74.08	1.005	Miscible	0.000022	-0.64	0.56

Notification Levels³

Nitrosamine	10 ⁻⁶ Risk Level (ng/L)	Notification Level ⁴ (ng/L)	Response Level ⁵ (ng/L)	PHG (ng/L)
N-Nitrosodiethylamine (NDEA)	1	10	100	--
N-Nitrosodimethylamine (NDMA)	3	10	300	3
N-Nitrosodi-n-propylamine (NDPA)	5	10	500	--
N-Nitrosodi-n-butylamine (NDBA)	3	--	--	--
N-Nitrosomethylethylamine (NMEA)	1.5	--	--	--
N-Nitrosomorpholine (NMOR)	5	--	--	--
N-Nitrosopiperidine (NPIP)	3.5	--	--	--
N-Nitrosopyrrolidine (NPYR)	15	--	--	--

Given the NDMA detections associated with drinking water sources and treatment, NDMA is a good candidate for future regulation (i.e. establishment of an MCL). A Public Health Goal (PHG) was established for NDMA in 2006; a PHG is the first step in the regulatory process.

Sources:

1. OEHHA. 2006. Public Health Goals for Chemicals in Drinking Water, n-Nitrosodimethylamine. December. <http://www.oehha.ca.gov/water/phg/pdf/122206NDMAphg.pdf>
2. <http://www.gsi-net.com/en/publications/gsi-chemical-database.html>
3. CDPH. 2011. NDMA and Other Nitrosamines – Drinking Water Issues. January 4. <http://www.cdph.ca.gov/certlic/drinkingwater/pages/NDMA.aspx>
4. Notification levels for NDEA, NDMA, and NDPA are established at 10 ng/L, somewhat above the de minimis level, to take into account the very low detection limits and their potential presence in association with drinking water treatment.
5. Response levels are levels at which the CDPH recommends removing the source from service, which corresponds to a 100 times the de minimis value.
6. ASTDR. 2011. ToxFAQs for n-Nitrosodimethylamine. March 3. <http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=883&tid=173>



What is NDMA?⁶

N-Nitrosodimethylamine (NDMA) is now produced by industry in only small amounts but may be formed in the environment from chemical reactions. It was formerly used to make liquid rocket fuel, but this use was stopped after unusually high levels of the chemical were found in air, water, and soil samples collected near rocket fuel manufacturing plants and rocket testing facilities.

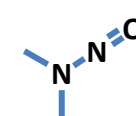
At room temperature it is a yellow, oily liquid with no distinct odor. It is used in some cosmetics, toiletry products, cleansers, and was used as an antioxidant. It is also found in some foods (i.e. meat, cheese, fish) and alcoholic beverages (i.e. beer, rum, whiskey, brandy), and may be formed in meats preserved by the addition of nitrates, nitrites, or cured by smoking (e.g. bacon).

NDMA is unintentionally formed during various manufacturing processes and in air, water, and soil from reactions involving other chemicals called alkylamines. It has also been associated with the chloramine drinking water disinfection process, and has been reported to be formed in the chlorination of wastewater used for aquifer recharge.

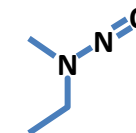
NDMA Fate & Transport⁶

- NDMA may be found in air, water, and soil.
- When released to the air, it is broken down by sunlight in a matter of minutes.
- In water, it may break down when exposed to sunlight or by natural biological processes.
- When released to soil it may evaporate into air, or it could also sink down into deeper soil.

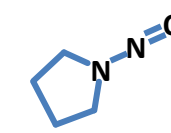
N-Nitroso- Compounds



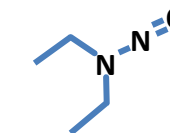
NDMA
(74 g/mol)



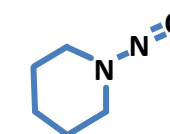
NMEA
(88 g/mol)



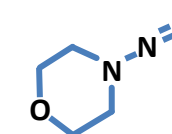
NPYR
(100 g/mol)



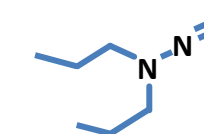
NDEA
(102 g/mol)



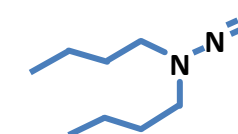
NPIP
(114 g/mol)



NMOR
(116 g/mol)



NDPA
(130 g/mol)



NDBA
(158 g/mol)