

**Pollutant Type:** *Particulate Matter*

**Pollutant/Metric Name:** Nitrate ( $\text{NO}_3^-$ )

**Description of the metric**

The metric nitrate ( $\text{NO}_3^-$ ) is defined as nitrate concentration measured in particulate matter ( $\text{PM}_x$ ). Measurement values are related to mass concentrations and usually reported in  $\mu\text{g}/\text{m}^3$ . Nitrate is a secondary aerosol, formed in the atmosphere from the oxidation of natural and anthropogenic gaseous precursors ( $\text{NO}_x$ ) to form nitric acid ( $\text{HNO}_3$ ), which is then neutralized and transformed in ammonium, sodium or calcium nitrate (Meszarós 1999). The size distribution of particulate nitrate depends on the neutralizing agent of the nitric acid. Ammonium nitrate presents mainly a fine grain size ( $< 1 \mu\text{m}$ ), while sodium or calcium nitrate species are mainly in the coarse range ( $> 1 \mu\text{m}$ ). Natural nitrate aerosols are usually formed from soil emissions (nitrification,  $\text{N}_2\text{O}$ ), forest fires ( $\text{NO}_2$ ,  $\text{NO}$ ) and electric storms ( $\text{NO}$ ). Regarding anthropogenic  $\text{NO}_x$  (the main contribution), they are emitted mainly by vehicle exhaust in urban areas and by energy generation (gas, fuel oil and carbon combustion), industrial processes and domestic and residential activities.

**Health Relevance**

Limited toxicological evidence for nitrate-containing PM does not support a causal association between particulate nitrate and excess health risks (Schlesinger & Cassee 2003, Reiss et al. 2007). Indirect processes may include interactions with certain metal species and/or linkage with production of secondary organic matter. Recent epidemiological studies find an association mostly with respiratory outcomes (Atkinson et al. 2010), although Ostro et al. 2011 also report statistically significant associations with all cause and cardiovascular mortality.

<i>Compound</i>	<i>Toxicological Information</i>	<i>References</i>	<i>Epidemiological information</i>	<i>References</i>
$\text{NO}_3^-$	Indication for indirect mechanisms, no evidence for causality	Schlesinger & Cassee 2003, Reiss et al. 2007	Increase in respiratory hospital admissions	Atkinson et al. 2010
			Short-term total and cardiovascular mortality	Ostro et al. 2011

**EC legislation, limit values**

Concentration levels of nitrate are not regulated in the EU Directive 2008/50/EC.

**Reference method for determination of the metric**

There is no EU reference method for the determination of nitrate

### Established Technology

Atmospheric nitrate aerosol concentrations are usually determined from filter samples, by performing a water leaching and determining the concentration of the soluble ions by ion chromatography.

### **References**

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- Mészáros E (1999). *Fundamentals of Atmospheric Aerosol Chemistry*. Akadémiai Kiado.
- Ostro B, Tobias A, Querol X, Alastuey A, Amato F, Pey J, Pérez N, Sunyer J. The Effects of Particulate Matter Sources on Daily Mortality: A Case-Crossover Study of Barcelona, Spain. *Environ Health Perspect*. 2011 Aug 16. [Epub ahead of print]
- Reiss R, Anderson EL, Cross CE, Hidy G, Hoel D, McClellan R, Moolgavkar S. Evidence of health impacts of sulfate-and nitrate-containing particles in ambient air. *Inhal Toxicol*. 2007 May;19(5):419-49.
- Schlesinger RB & Cassee F. Atmospheric secondary inorganic particulate matter: the toxicological perspective as a basis for health effects risk assessment. *Inhal Tox* 2003; 15: 197-235.

Author(s):	CSIC, Spain	
Co-author(s)	Klea Kasouyanni Evi Samoli	NKUA, Greece NKUA, Greece
Last revision:	06.02.2013	U. Sager/A. John, IUTA