Diffusive Sampler for Total Nitrogen NO_x

Effects and Limit values

NO_2 and NO_x have implications for acidification of ecosystems and formation of ozone. It is pointed out that synergistic effects are very important and the guideline is given for NO_x rather than NO_2 alone.

WHO recommended a guideline to protect vegetation as an annual average of 30 µg/m^3; for NO_x, calculated as the sum of NO and NO_2 in ppb and expressed as NO_2 in mg/m^3

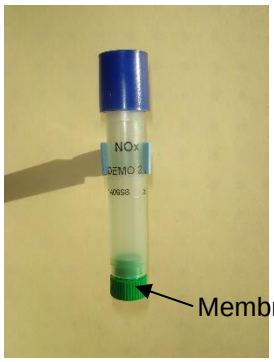
Annual limit value for the protection of vegetation 30 µg/m3 [1]

Sampler design

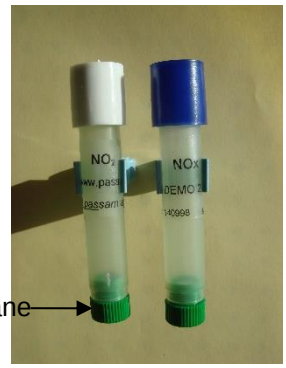
The sampler is based on that of Palmes. The absorbing medium contains an oxidant, which transform NO to NO2. The amount of NOx is trapped as total nitrite

The measurement of NO_x is carried out with two different samplers: firstly NO_2 is assessed with Triethanolamine and secondly NO + NO_2 is trapped after transforming NO into NO_2 with an oxidizing agent in the TEA

The samplers are placed in a special shelter to protect them from rain and minimize the wind influence. To avoid the influence of vertical air turbulences at high trafficked roads, Membranes shall be used.



Direct measurement as NO_2 equivalents



Indirect measurement via NO measurement

Direct Measurement

NO_x is determined as the total amount of nitrite

$$C_{NOx} = \frac{Q_{NOx}\ [\mu g] \cdot 10^6}{SR_{NOx}\ [ml/min] \cdot t\ [min]} \quad [1]$$

C_{NOx} is expressed in NO_2 equivalents in µg/m^3

Indirect measurement

The measurement is done by NO_2 and NO_x tube simultaneously.

First, the NO_2 concentration is calculated according to [1]

Second: based on the difference NO_x and NO_2 as nitrite, the concentration of NO is calculated

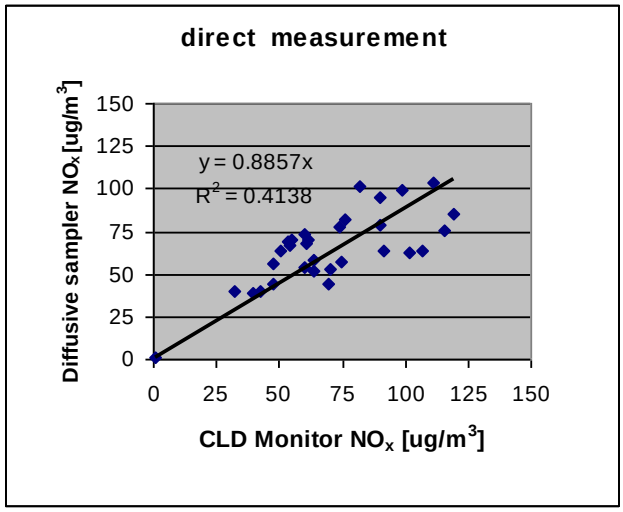
$$C_{NO} = \frac{(Q_{NOx} - Q_{NO2})\ [\mu g] \cdot 10^6}{SR_{NO}\ [ml/min] \cdot t\ [min]} \quad [1]$$

The concentrations of NO_2 and NO are added:

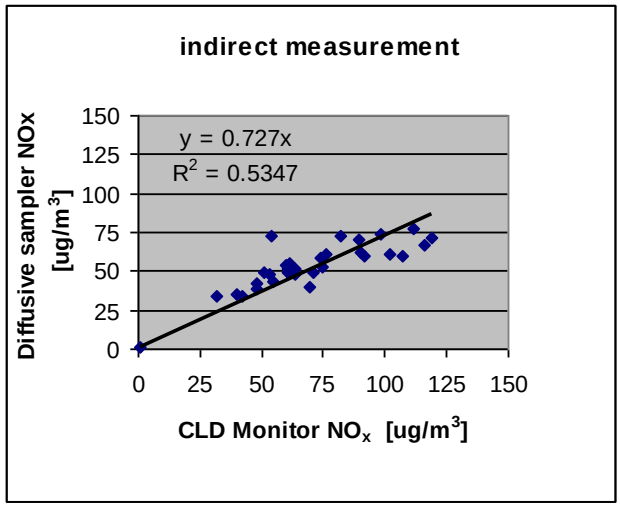
$$C_{NOx} = C_{NO2} + C_{NO} \quad [\mu g/m^3]$$

C_{NOx}: ambient concentration [µg/m^3]
Q: mass absorbed [µg]
SR: sampling rate [ml/min]
CF: Conversion Factor µg/m^3 → ppb

Specifications



The diagram shows the comparison of NO_x diffusive samplers and NO_x (sum of NO + NO_2 in µg/m3) measurements of different continuous monitoring sites in Switzerland 2006.



There is an underestimation of the diffusion tube measurement. This might be due to the fact, that CLD monitors collect also higher Nitrogen oxides

Sampling rate Nitrogen dioxide	0.7432 ml/min equipped with protective filter	
Sampling rate Nitrogen monoxide	0.9566 ml/min equipped with protective filter	
Working range	1 – 200 µg/m^3	
Sampling time	1 to 4 weeks	
Detection limit	1 µg/m^3 for sampling periods of 4 weeks	
External influences: wind speed	influence of wind speed < 10% up to 4.5 m/sec use of membranes at highly trafficked sites recommended	
temperature	no influence between	10 to 30°C
humidity	no influence between	20 to 80%
Storage	before use: after exposure:	6 months 6 months
Cross sensitivity	Specific method	
Expanded uncertainty*	22.4 % at 30 µg/m^3 equipped with protective filter	

*according to GUM; subject to change without notice

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References

[1] Council Directive 1999/30/EC relating of limit values for SO_2, NO_2 and oxides of Nitrogen, 22 April 1999

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