Tunnel Atmosphere Monitoring

NO2 Control in Road Tunnels

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The need to minimise NO2 exposure in road tunnels has been inhibited by the lack of suitable, low-maintenance sensors for measuring ppb levels of NO2. Recent improvements in technology have resulted in the introduction of not one but two competing techniques designed specifically for this application, making the possible control of tunnel NO2 levels a reality rather than just a desire.

- **NO2 should now be a key control parameter.**
  NO2 is particularly toxic. Levels higher than 1ppm can be harmful to healthy people. Lower levels as low as 0.1ppm will harm asthma sufferers.

- **Current ventilation strategies based upon CO and visibility are inadequate.**
  It is assumed that if safe operating CO levels are maintained then other gaseous emissions will also be safe.

- **CO levels are now too low to be an appropriate control parameter.**
  The introduction of catalytic converters has produced a major reduction in exhaust CO emissions. CO levels in tunnels rarely exceed the ventilation control trigger points.

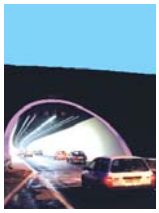
- **NO is not considered to be a harmful pollutant in tunnels.**
  At concentrations prevalent in tunnels NO is not itself a harmful pollutant and has no purpose as a control parameter. It has been used to infer NO2 levels in the absence of low cost reliable NO2 sensors.

- **NO2 cannot be inferred from the measurement of NO.**
  To infer NO2 from NO measurements, the ratio of NO2/NO is taken to be 1:10. Recent tunnel test data shows that the ratio is actually variable to values greater than 1:3, resulting in serious under reporting of NO2 values.

- **New measurement techniques make NO2 a viable parameter for control.**
  Two new monitoring techniques have been tested and approved by CETU in France for the measurement in the range 0 to 2ppm of NO2 in road tunnels. One uses an ultraviolet scanning spectroscope technique known as Differential Optical Absorption Technology (DOAS), the other a far simpler Single Wavelength Optical Transmissometer (SWOT).

No.1 in Tunnel Atmosphere Monitoring





Recommendations for NO2 Limits

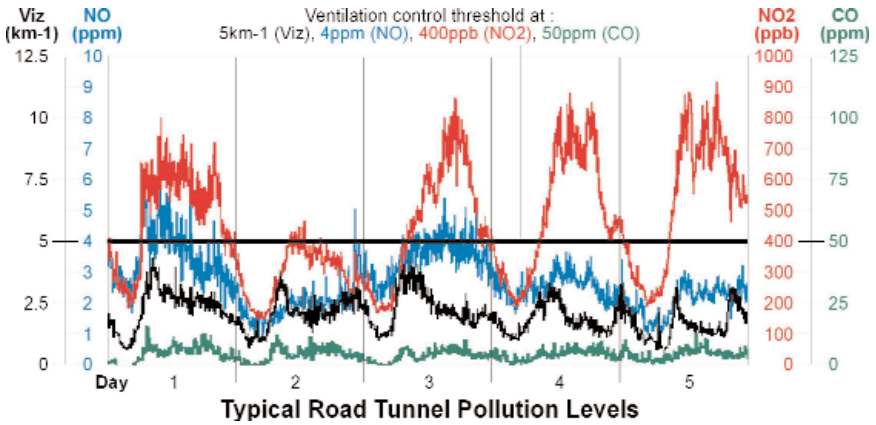
World Health Organisation (2005) - Recommends an upper limit of 200µgm/m3 (100ppb) for a 1 hour exposure.

PIARC (2000) - Exposure to levels higher than 500µgm/m3 (250ppb) for 30minutes can impact on the health of sensitive people.

CETU France (Centre d'Etudes du Tunnels) - Following Circulaire 99.239 of 8 Juin 1999 (Ministière de la Santé) the following limits are recommended
- 400ppb for 15minutes - NO2
- 50ppm for 30 minutes - CO
- 90ppm for 15minutes - CO

NO2 : NO Ratio

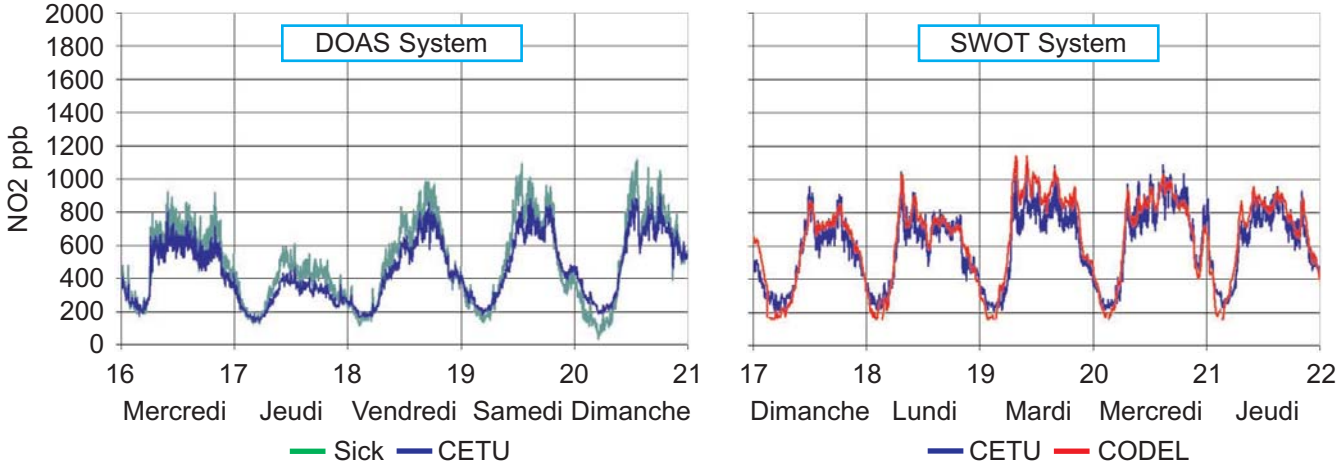
Data from CETU illustrates the importance of NO2 for ventilation control. Traditional control parameters CO & visibility are significantly below control threshold levels; NO2 is persistently above the control threshold. The data also shows how the NO2/NO ratios vary from 1:20 to 1:3. Inferring NO2 levels from a measurement of NO is not reliable. A direct measurement of NO2 is essential for control.



Typical Road Tunnel Pollution Levels

Sensor Comparison Data

CETU compared the outputs from two NO2 sensors, one a DOAS system from Sick, the other a SWOT system from CODEL, against a chemiluminescence analyser in month-long trials. The accompanying charts show typical 5-day operational periods for each sensor and demonstrate the good agreement of both systems against the standard analyser.



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