16TH AUSTRALASIAN TUNNELLING CONFERENCE 2017

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Tunnel Infrastructure Projects – Managing Risks to Air Quality

From an air quality perspective, tunnels capture vehicle emissions and release them through ventilation structures and portals, otherwise normally discharged by vehicles travelling on surface roads.

Vehicular Traffic Emissions

Main components of emissions from vehicular traffic include:

- PM_{10}, $PM_{2.5}$
- NO_x, CO
- BTEX, formaldehyde and 1,3-butadiene
- PAHs as benzo(a)pyrene equivalents

Legislative Framework in Victoria

- Environment Protection Act 1970
- State Environment Protection Policy (Ambient Air Quality)
- State Environment Protection Policy (Air Quality Management)
- Environment Protection (Scheduled Premises) Regulations 2017

Considerations in Tunnel Ventilation Systems Design

- in-tunnel air quality
- height of the tunnel ventilation structures
- operation of the fans
- ventilation structure emission limits
- design criteria
- portal emissions

In-Tunnel Air Quality

In-tunnel air quality (CO and visibility) are monitored to:

- control in-tunnel exposure to CO through compliance with criteria
- ensure appropriate visibility for all tunnel operating conditions
- prevent or reduce portal emissions

A NO_2 in-tunnel concentration limit is currently not prescribed in Victoria.

Ventilation Structure Emission Limits and Design Criteria

Tunnel ventilation system design is required to meet both:

- ventilation structure emission limits
- design criteria for new sources of emissions

Dispersion modelling is a key tool to:

- ensure the tunnel design can meet the necessary air quality requirements.
- assist the design team in optimising the physical characteristics of the ventilation system.

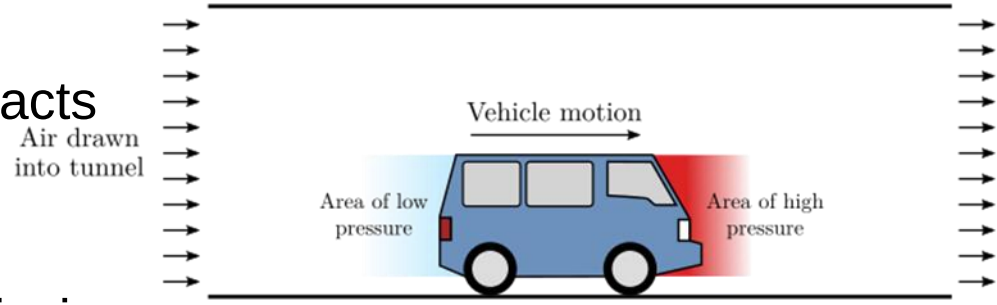
Portal Emissions

Currently in Victoria and Australia, best practice tunnel design stipulates zero portal emissions i.e. exhaust air is not permitted to exit the tunnel at the portals.

Portal Emissions

The requirement for zero portal emissions at design stage has the effect of:

- increasing the size of the tunnel ventilation system
- higher capital costs
- potential for adverse visual impacts
- increasing operational costs
- reducing energy efficiency
- increasing greenhouse gas emissions



Portal Emissions

Main reasons for zero portal emissions requirement is:

- protect nearby sensitive land uses
- prevent exceedances of air quality standards

Local air quality maybe affected in the immediate vicinity of portals.

However, studies have shown that beyond 200m, portal emissions are indistinguishable from surface road emissions.

Portal Emissions

Fresh approach required to designing future tunnel ventilation systems that allows for portal emissions:

- modelling of portal (or partial) emissions to determine impacts
- siting portals away from sensitive areas e.g. residential
- land rezoning or property acquisitions at locations where predicted impacts exceed air quality standards

Portal Emissions

- conducting continuous monitoring of PM_{10}, $PM_{2.5}$ and NO_2 to:
  - establish baseline conditions
  - confirm the veracity of model outcomes during operation
  - compare air quality concentrations before and after tunnel opening to determine changes

Recommend a shift away from the historical approach of ‘zero portal emissions’ at design. To be considered at the early stages of a tunnel project to discuss and address stakeholder concerns.

Case Study: CityLink – Melbourne

- two three-lane tunnels of 3.4 km (Domain tunnel) and 1.6 km (Burnley tunnel) in length
- emissions from ventilation structures and in-tunnel air quality concentrations subject to licence requirements
- portal emissions allowed 8pm - 4am (Domain tunnel exit only)
- continuous emissions monitoring of PM_{10}, $PM_{2.5}$, NO_2, CO and benzene
- ambient air monitoring studies have indicated **no** impact on local air quality

Case Study: CityLink – Melbourne

Case Study: EastLink – Melbourne

- two 3-lane tunnels,1.6 km in length
- emissions from ventilation structures and in-tunnel air quality subject to licence conditions
- ambient air monitoring studies have indicated **no** impact on local air quality
- portal emissions permitted at specific times
- application for a licence amendment to permit partial portal emissions during the day

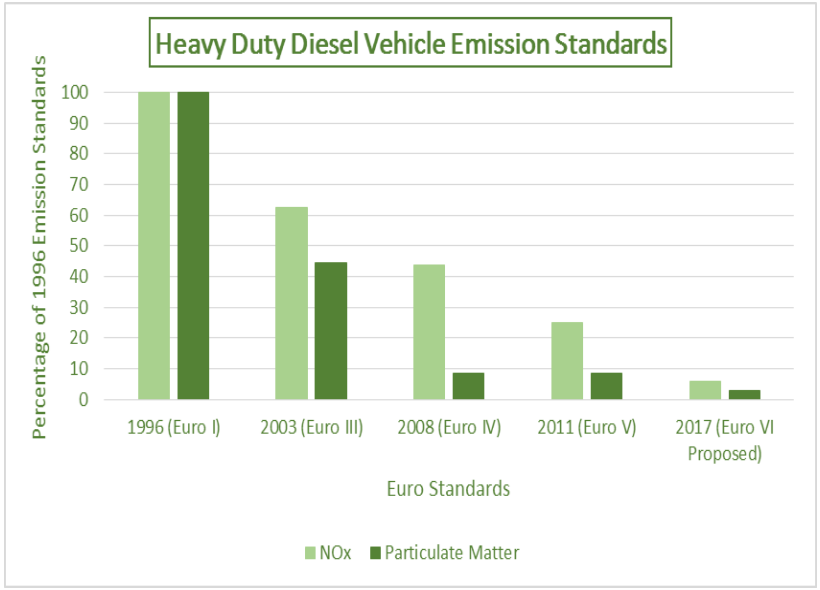
Future of Emissions from Vehicular Traffic

EPA's 'Future Air Quality in Victoria' report (2013) predicts:

- a significant reduction in CO and NO_2 concentrations over the next 20 years
- a reduction in $PM_{2.5}$ emissions from diesel vehicle engines by 2030

- Australia has adopted the Euro V standards
- considering the case for adopting the Euro VI standards

Future of Emissions from Vehicular Traffic



- Euro V – 92% (NOx) & 75% (PM) reduction of 1996 standards
- Euro VI – 94% (NOx) & 97% (PM) reduction of 1996 standards

Conclusion

- impacts from road tunnel ventilation structures are low and mostly indistinguishable from other pollutant sources
- ambient air monitoring post-opening of CityLink and EastLink tunnels indicated no impact on local air quality
- continual improvements in vehicular traffic emissions through tougher emission standards and technology improvements
- fresh approach required in permitting portal (or partial) emissions to be considered at the early stages of a road tunnel project.

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Q&A