

Turning the spotlight on tunnel pollution

As traffic is increasingly being diverted underground, road authorities are on the hunt for suitable filtration technology. Richard Collins looks at a promising solution.

The NSW Roads and Traffic Authority has finally admitted that filtration technology does have a role to play in cleaning air from traffic tunnels. It recently backed away from its long-stated view that filtration systems offer no improvement on ventilation systems, which simply suck the air out of a tunnel and disperse it through tall stacks.

Now the RTA has called for expressions of interest in developing a pilot filtration system that can reduce NO₂ emissions by 90 per cent and particulates by 80 per cent. The question is which technology? With tunnels proliferating in most Australian capitals and growing concerns about the long-term health impacts for those in and around them, the debate is being followed with interest around the country.

Possible technologies include electrostatic precipitators (ESP), wet chemical scrubbers and bio-absorbing beds. ESPs are the leading contender having been employed in Japanese and Norwegian tunnels for years and used extensively in power plants. But Paul Howlett of Stack Management Systems (SMS) has developed a new approach he says is far more sustainable, based on micro-turbines. It may also have industrial applications handling odours from waste processing and treatment plants, and volatile organic compounds (VOCs) from manufacturing and processing plants.

The SMS technology draws polluted air into the turbine through a particle filter, which captures any large particulate contaminants. The air is compressed and mixed with natural gas, then combusted and the hot gas used to drive the power turbine. It would consume all unburnt hydrocarbon and VOCs in tunnel air and, Howlett predicts, 90 per cent of the particulate matter, turning it into electricity, heat and kinetic energy.

"Most clean up systems are parasitic. They sit at the back end of a process and clean up pollution, but cost money. This provides energy and value back into the business (or project) to help amortise the cost of clean up," he said.

It could power the tunnel lights and, depending on the size of the system, even feed electricity back into the grid. On a bigger picture, it removes the need for coal-fired sources, which have low thermal efficiency, and takes fans out of the picture altogether.

The initial capital cost of gas turbine technology might be relatively high, but Howlett says it could be brought down by a smaller system offering "selective extraction and filtration in those areas where the pollution discharge is greatest". The real savings could be in operating costs. Where ESPs increase the running costs of a tunnel system, the SMS technology would pay for itself – Howlett claims in 10-20 years – depending on configuration. The lengthy period shouldn't be an issue, he maintains, as no other system offers payback at all.



Polluted tunnel air poses health risks for those in and around them.

UNTESTED

Turning a tunnel into a net energy source is an elegant idea, but largely untested. For example, there is very little thermal energy in tunnel air, so any efficiency gain is likely to be small. The heat could also be used to generate power, but cogeneration is complex and would need to be proven in this application. And gas turbines produce NO₂, one of the key substances to be removed.

Electrostatic precipitators have their problems too. The laden air passes between two electrically charged plates, which ionise the particulates so they are attracted to a plate and can be removed. Applications have been of limited success and, according to an RTA report following a visit to Norway, the precipitators are often not operated or only run on demand. They also struggle to handle the smallest of particles, the PM_{2.5} and PM₁ matter that presents the greatest dangers to health. The technology has developed, however, including systems to agglomerate the tiny particles to improve the attraction, so the option is alive.

According to Howlett, no alternate options offer the broader benefits of the SMS approach. Stack Management Systems is a partnership of Howlett, a leading figure in Australia's waste and resource management scene, and technology development company Advanced Emissions Control. Collex is investing in development of the technology.

SMS has also just signed a licencing deal with Italian company Global Engineering for the local rights to a paint coating that absorbs smog, particularly nitrogen oxides. The photocatalytic surface is being tested on roads and tunnels in Europe, with positive early results. Howlett plans to have these de-noxifying units at the front and back of the system to resolve the NO₂ issue. The cleaned air could then be returned to the tunnel, further reducing contaminant levels.

SMS TECHNOLOGY APPLICATIONS

The core components of SMS Technology have been used in many applications, including cogeneration of power and cleaning up foul or sour air streams in situations such as oil fields, landfills and industrial plants.

“It can be used in any application where there is an odour, as it is combustible,” said Paul Howlett. “Where other systems are parasitic in terms of cost and (process) load, this generates energy which can be beneficially used.”

The approach has been implemented in a US sewage treatment plant and Howlett says another potential application would be in a compost plant. The turbine-heated air, at around 250°C, could be fed back into the compost pile to increase the rate of break down, possibly reducing the required footprint by up to 25 per cent.

He is importing a small 30kW unit from the US to run some trials in waste applications in coming months, but won't reveal more.



Photocatalytic paint is being tested in Europe to absorb smog.

“We believe it is conceivable to eliminate stacks and disperse air through the (entry and exit) portals, which (the Department of Infrastructure, Planning and Natural Resources) does not allow at the moment,” he said.

If it can be made to work, the benefits are significant. Howlett has his work cut out, with a reluctant RTA likely to back a conservative option, especially as tunnel filtration technology is developing so quickly and with so much political sensitivity around the issue. ■



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