Hansom
Environmental Products
Innovative Emission Solutions

World leaders in environmental technology for air pollution control

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11 September 2014

Mr Tim Parker
Project Director
Northconnex
Locked Bag 928
North Sydney NSW 2059

Dear Mr Parker

Hansom Environmental Products (HEP) Pty Ltd (formerly Indigo Technologies), is a pollution control and technologies development company and sole owner of world patented Fine Particle Agglomeration Technology.

Based in Sydney, our company would be instrumental in solving environmental concerns of fine particulate emissions from the Northconnex tunnel stacks.

We feel certain that it would be of great value to Northconnex to have access to this award winning technology which can be retrofitted to existing installations.

There are considerable, valid concerns put forward by medical professionals, local councils and community groups regarding the air quality around the stacks, specifically $PM_{2.5}$ emissions and those well into the sub-micron range. This technology will give Northconnex a viable and cost effective solution to address these concerns.

We would appreciate you spending some time to consider this technology and we look forward to further discussions with you.

Your sincerely

D S. Hansom.

David Hansom B.Eng
Managing Director

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Why Northconnex should consider this technology

Environmental issues around Particle Emissions and Air Quality

We have studied your Environmental Impact Statement (EIS), with reference to environmental issues regarding air quality. According to your EIS risk assessment, the impact of air quality in the vicinity of the ventilation outlets is deemed to have 'insignificant consequences' with a 'low' risk rating.

Local resident action groups and medical professionals are extremely concerned and have been mobilising for some time. They are demanding solutions because your conclusions are contrary to numerous research findings on the negative impact of fine particulate emissions to human health.

Studies of health risks prove that ultra-fine particulates are highly problematic as they are more readily absorbed into the bloodstream.

As outlined in the report produced by Katestone Environmental to Pike Pike Fenwick: Review of Lane Cove Tunnel PM_{10} impact Issues – April 2003.

Road traffic is a major source of PM in urban areas. Road traffic emissions are the result of car exhaust, wear of tyres and brake linings and, indirectly, the re-suspension of road dust, crustal and organic. In general, these PM emissions are characterised by their mass and size (PM_{10} and $PM_{2.5}$), by the number of particles or by chemical composition. Most research of PM emitted by road traffic has been related to PM_{10} and $PM_{2.5}$. Recently, more research has also focused on the number of particles, the largest numbers of which are smaller than 0.1µm, the so-called 'ultra-fine' particles (UF).

A study in Queensland, Netherlands and United Kingdom has shown that:

- *Street canyons (and probably tunnels) that cause enclosure of air pollution result in relatively high concentrations of coarse (PM_{10}-$PM_{2.5}$) material, mainly as a result of the resuspension of road dust. These resuspended particles are of a coarser fraction than direct exhaust emissions (Aben et al 2002).*
- *Measurements in European tunnels show that the size distribution of emitted particulates depends strongly on traffic volume (and time of day), and agglomeration in the tunnel results in particle size increasing from 30-40nm to 80-100nm - this is not found in ambient air.* (Note:The very same principle that has brought about this agglomeration within the tunnel, is one of the underlying principles behind the HEP Agglomerator where agglomeration efficiencies are 1000 times greater.)
- *Emissions of PM_1 from diesel vehicles are especially important and can vary considerably between different operation modes and how vehicles are maintained.*

No filtering of particulate matter has been planned for the Northconnex tunnel so the same problems will be confronted. These problems can be addressed **now** in the planning process and residents minds put at rest in the knowledge that something is being done to protect their health and that of their families.

About the technology

By combining an HEP Agglomerator with a Wet Electro Static Precipitator (Wet ESP), HEP Technologies has created the HEP Fine Particle Control System (HEP-FPCS). The HEP-FPCS is specifically designed for the removal of the highly dilute particle concentrations, ultra fine particle size distributions and low resistivity particles typical of road tunnel applications.

As a consequence of its design the HEP Agglomerator generates extremely high efficiency mixing and interaction of suspended particles to cause their collision and growth to larger sizes (see figure 2), greatly enhancing their removal in a downstream Wet ESP. The HEP Agglomerator has demonstrated sub-micron removal efficiencies >95% and when combined with a Wet ESP – removal efficiencies typically >99% for ultra fine particles – the HEP-FPCS assures particle removal rates in excess of those typical of ESPs alone.

Furthermore, to address sulphur dioxide levels, a wet scrubber can be placed in front of the Agglomerator which will enhance the mixing process and improve the removal of this gas. See figure 1: Agglomerator installation at Watson Power Plant USA showing SO2 scrubber tubes in front of the Agglomerator (at right).

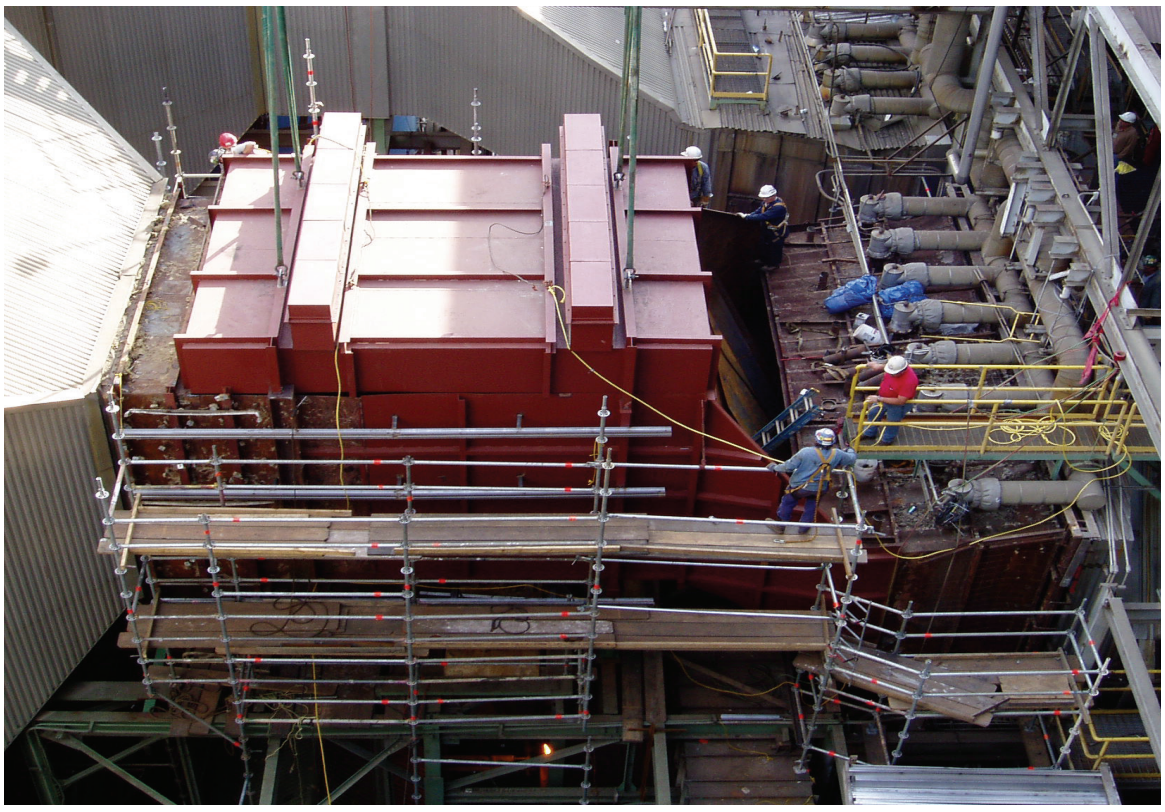

Figure 1: Agglomerator installation with SO2 scrubbers at Watson Power Plant USA

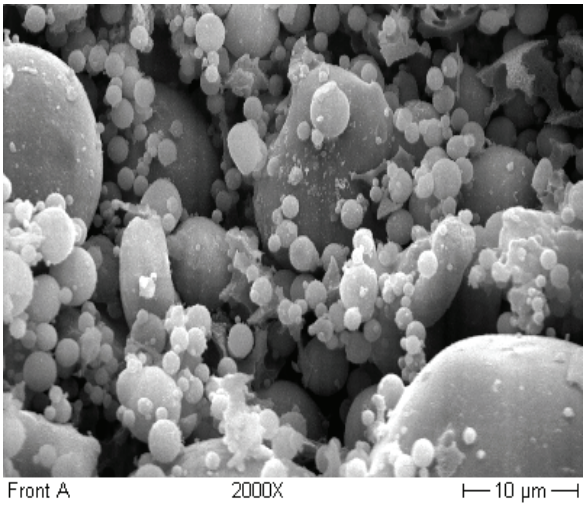

Figure 2: Fine particles attach to larger particles and form agglomerates

A multi-process technology that incorporates fluidic, physical and electrostatic processes to remove fine particles ($PM_{2.5}$) by attaching them to larger particles.

When used with an ESP, Baghouse or Scrubber, the HEP Agglomerator will enhance the dust collection and reduce Opacity.

When used with upstream sorbent injection, the HEP Agglomerator will enhance the sorption process thereby reducing SOx emissions.

The flexibility of design and operation of the HEP-FPCS allow it to be used for in-tunnel or end-of-line applications at scales ranging from 10m3/sec up to 250m3/sec, the final configuration being limited only by space and the desired outcome. The HEP-FPCS can bring the high efficiency, low maintenance and low operating cost benefits of the Agglomerator and Wet ESP technologies together in a package specifically tailored to address the challenges of the Northconnex tunnel.

Testing the technology

The technology that underpins the HEP-FPC System – Agglomeration, water atomisation, wet scrubbing and wet ESPs – has been demonstrated on many industrial applications around the world, while Water Scrubbing in conjunction with Wet ESP collection is quite common practice.

ESPs in general do not entirely address $PM_{2.5}$ although wet ESPs are more efficient. The real problem is in the sub-micron range where ESPs are ineffective unless coupled with a suitable Agglomerator such as the one developed by HEP.

Furthermore, HEP, in collaboration with the University of Adelaide has conducted extensive water droplet testing of Agglomeration. HEP well understands the process and its efficiencies and can demonstrate unambiguously the agglomeration process using water droplets (see figure 3).

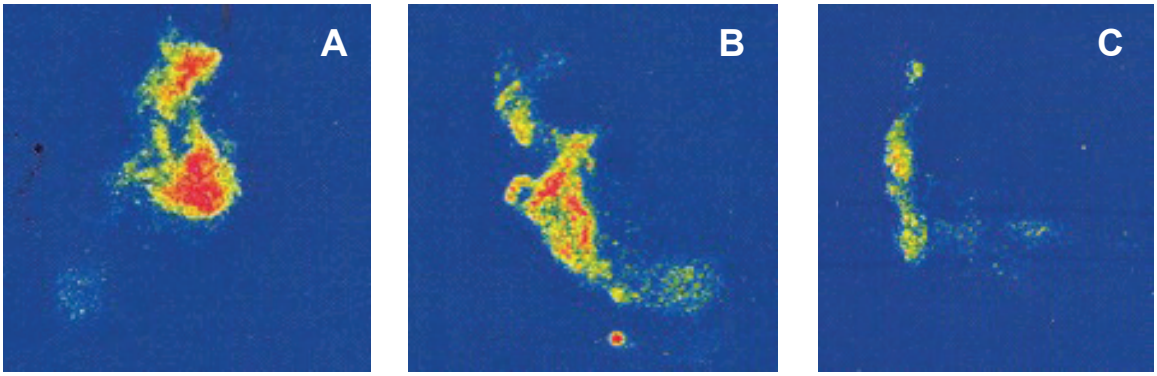

Figure 3: High speed photographic visualisation of the agglomeration process using laser induced florescence (LIF)

A. 1µm water droplets only: Doped water droplets fluoresce in a laser sheet and can be photographed. Note that no Agglomerator is present in this test, the colour represents the particle number concentrations of 1µm water droplets with no agglomeration.

B. 1µm and 10µm water droplets: Undoped 10µm droplets do not fluoresce so are invisible to the camera. Note that there is a redistribution of the 1µm water droplets but since there is no Agglomerator present the 1µm and 10µm do not interact and there is no change in the number of 1µm water droplets.

C. 1µm and 10µm water droplets with an Agglomerator present: Agglomeration causes large undoped droplets to interact with the small fluorescing droplets, the result is that the small droplets get absorbed/diluted by the large droplets and cease to fluoresce. Agglomeration causes a reduction in small droplet numbers. Agglomeration with water is photographed.

Winner of the 2007 J. Deane Sensenbaugh Award

The prestigious J. Deane Sensenbaugh Environmental Technology Award is presented by Air Waste and Management Association (USA) to companies or individuals in recognition of outstanding achievements in the field of air pollution control or waste management. In 2007 the award was presented to Hansom Environmental Products for the development of the HEP Agglomerator to reduce fine particulate matter ($PM_{2.5}$) emissions.

Developing a trial

HEP would welcome the opportunity to offer this technology to Transurban as a solution to addressing concerns regarding fine particulate emissions from the Northconnex tunnel stacks. HEP is confident in the ability of the technologies proposed to deliver efficient control of particle emissions. Although this technology has been aimed at the power generation industry, the results achieved over a number of years indicate that it is highly suitable for this application. HEP recommends that at minimal cost to the Northconnex project, a trial be set up on a pre-existing tunnel stack.

Overall benefits of the HEP Agglomerator

- Reduced mass emissions
- Reduced visible emissions/opacity (sub-micron particles)
- Reduced $PM_{2.5}$ emissions
- Reduced Mercury emissions
- Greater compliance safety margin
- No fan upgrade required
- Low maintenance and operational cost
- Ease of retrofit – minimal outage time
- No additional real estate required

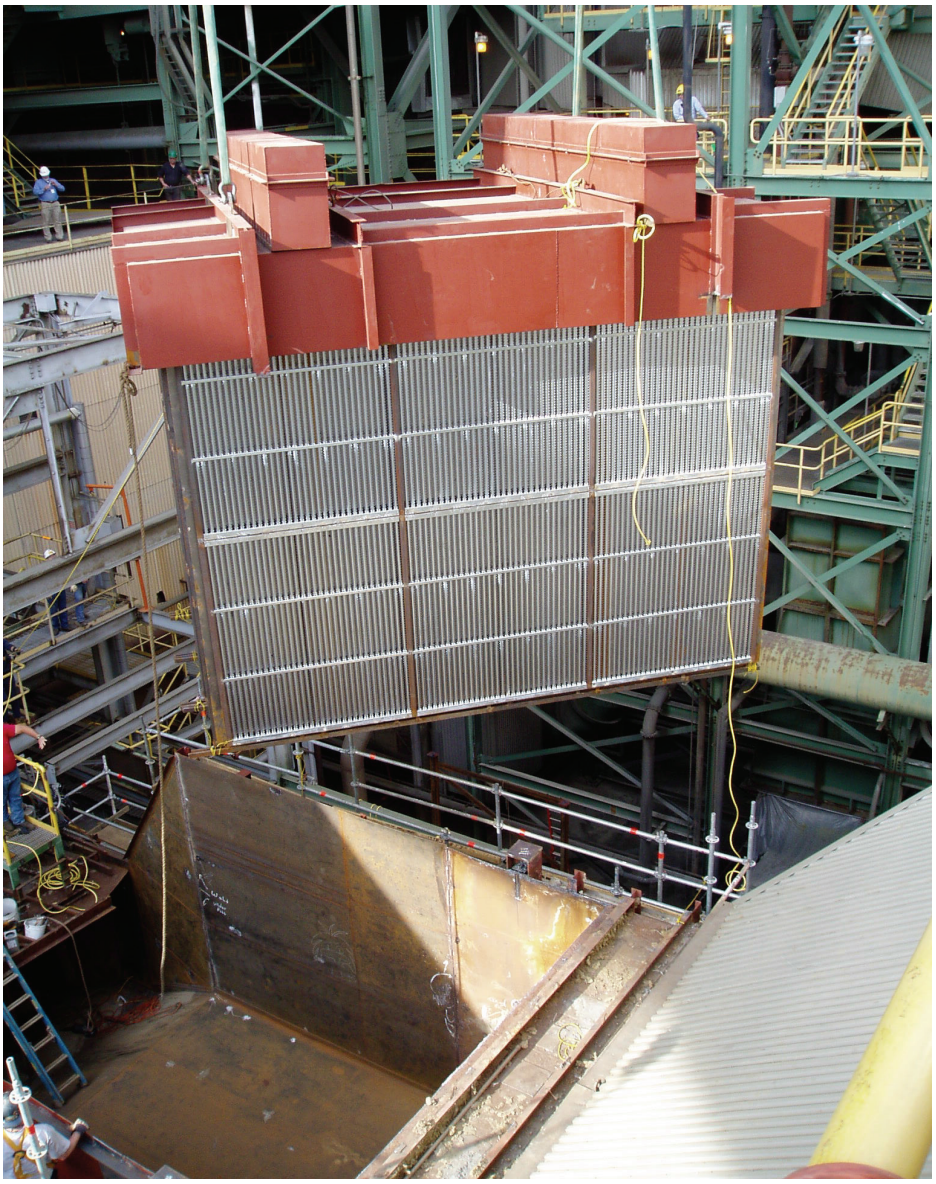

Figure 4: Agglomerator emitter arrays at Watson Power Plant USA