Fugitive Emissions can be addressed in a creative, cost effective and sustainable way.

Fact Sheet

Filtering Particulates

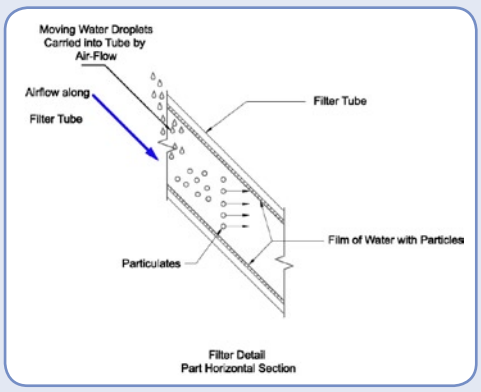
Filtration of polluted air in traffic tunnel to remove particulates is not common, but emerging as an area that is being addressed. The big challenges facing technology proponents are that:

- the total amount of particulates contaminating traffic tunnel air is very small relative to other industrial situations where filters are used such as power plants, steel mills and other process industries, and
- the vast majority of the harmful particulates are in the sub-micron (very small) size range that are not easily trapped by conventional filtering technologies.

Typical of the technologies being trialled to filter particulates in traffic tunnels are electrostatic precipitators and bag filters. These systems are being up-lifted from other industrial applications where particulate quantities and sizes are significantly greater than those found in polluted air in traffic tunnels.

SMS, on the other hand, has selected a filter media that is primarily manufactured and sold for evaporative cooling and air humidification. It is also commonly used with gas turbine engines to pre-condition and filter combustion air prior to compression in the turbine. The filter media is renowned for its exceptionally high surface area per cubic metre, the remarkably low drop in pressure across the media, and its unique multi-mode methodology for cleaning and conditioning air. Key application areas for conditioning air streams and humidity control are commonly found in the power, pharmaceutical, food and transport sectors.

The cellular structure of the filter media selected presents around 500 square metres of surface area per cubic metre of media, dramatically increasing the probability of particle capture within the filter. The filter design and application invokes all three common inertial (Newtonian) forces for the collection of contaminants carried in gas streams – impaction, interception and diffusion – with impaction the most prevalent mechanism.



A film of water flows over the tubular cells. The contaminated air is directed along the tubular pathways where the contaminants are accelerated and forced to ***impact*** onto the surface of the tubes or into a liquid droplet that is passing along the tube. The kinetic energy of the particle is used to penetrate the surface tension of the scrubbing liquid, allowing the latter to enclose the particle, raising its density so that it may be inertially separated more easily.

Those particles, which do not directly impact, can be captured by ***interception***. Here the particles meet the droplets at angles of less than 90 degrees, yet still have sufficient energy to cause the droplets to engulf them. Interception is droplet density related. The chances for interception increase when the droplet density increases. Interception is most prevalent on submicron particles which, given their low mass, tend to follow gas streams. Their kinetic energy levels are not enough for impaction, but their characteristic small size and random motion encourage interception.

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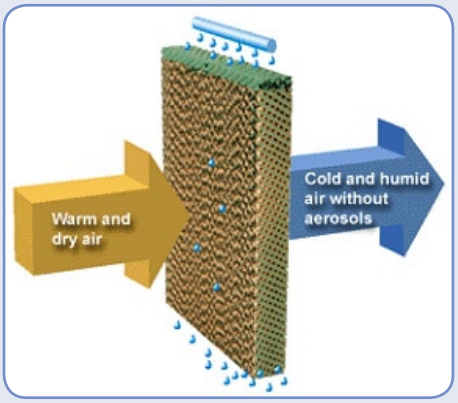
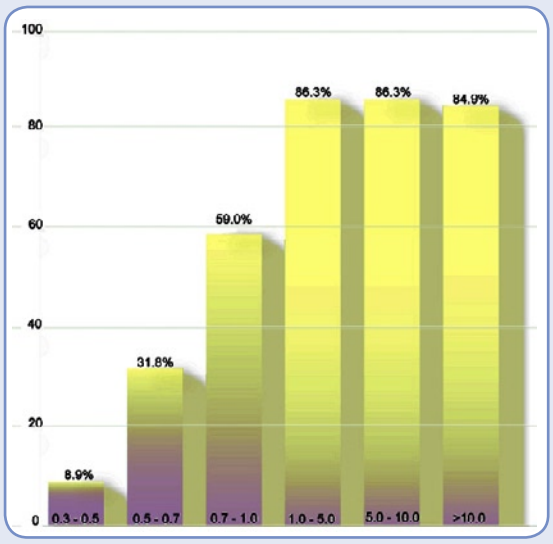
Diffusion is most notable in particulates less than 0.5 microns in size. These particulates migrate through the scrubbing liquid spray along lines of irregular gas density and turbulence. This diffusion action brings them into contact with liquid droplets in which there is little energy difference between the collecting liquid and the contaminant. Since evaporation is occurring in the filter there will be zones of different density of air and water mixture. This causes particles to pass from zones of higher density to less dense zones and hence increases the probability of capture via diffusion.

Through these capture mechanisms, particulates in the air flowing through the filter media are brought to a stand-still and entrained in flush-water. The filter media is maintained clear and functioning through the passage of a film of water across the face of the media and along the cellular tubes. Particulates are continuously washed from the filter media and captured in a sump-drain system for removal. A significant proportion of the water can be reclaimed for re-use with make-up water added as required.



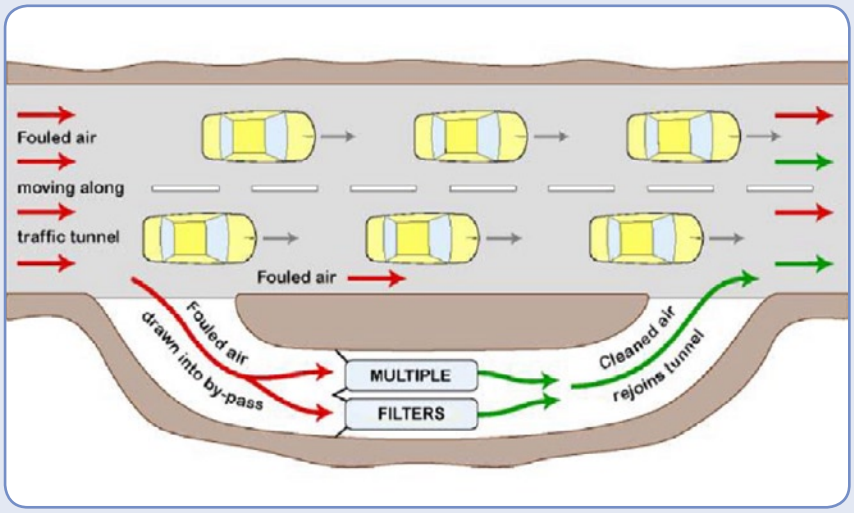


Data based on ASHRAE standards for particulate capture efficiency, indicate the following performance characteristics for the filter media selected by SMS:

Particle Size Range	% Capture Efficiency
0.3 – 0.5 µm	8.9%
0.5 – 0.7 µm	31.8%
0.7 – 1.0 µm	59.0%
1.0 – 5.0 µm	86.3%
5.0 – 10.0 µm	86.3%
>10.0 µm	84.9%

From this indicative performance data, and using publicly available data on particulate pollution levels in traffic tunnels, the following performance capabilities are expected from the SMS filter system for particulate filtering:

	Input	Output	Reduction
Particulates PM10	400 micro grams/N.Cu.M	70 micro grams/N.Cu.M	82.5%
Particulates PM 2.5	150 micro grams/N.Cu.M	40 micro grams/N.Cu.M	73.3%



The particulate filter systems that SMS is developing are compact and highly efficient. The capital cost is only a fraction of the alternative technologies while the operating and maintenance costs are minimal. With its compact size and performance, the SMS particulate filter system is highly flexible for building into multiple configurations for installation in traffic tunnels, and retrofitting options are very viable. One option for an installation is shown in a conventional by-pass configuration to clean fouled air and return it to the tunnel, significantly diluting the particulate pollution levels in a tunnel.

For further information

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