



*Salt Pony 400 is used to clean metro tunnels.*

# Technology to the rescue

An Italian company, Tecnofer, has developed a new system to remove rubbish, dust and other contaminants from railway tunnels, reports **Dr Ernesto Mancusi**, senior member of the Italian Railway Engineers Association.

**R**AILWAY tunnels, especially on metros, are dangerous places for track workers, as well as passengers in an emergency, because they are often dark and dirty and difficult to escape from. Therefore anything which can improve the situation, such as removing dust accumulation, is to be welcomed.

Both coarse and fine dust particles are deposited in tunnels from the movement of trains, especially during braking and when negotiating curves. Track maintenance activities, particularly rail grinding, also produce dust. On metros, passengers waiting on station platforms also create dust and other debris.

Railway dust is insoluble in water and comes from a derivative of iron, copper, aluminium, and silicon. If the

composition of the dust exceeds legal limits, particularly in the aquifer, it can become a health risk, although it does not represent a particular danger for environmental pollution.

### Dust accumulation

The accumulation of dust in railway tunnels can cause the following problems:

- obscuring of signs
- obstruction of air treatment filters both on trains and in technical rooms
- increased risk of malfunction for telecommunication and signalling equipment
- increased maintenance requirements both on trains and in the tunnel
- reduced light intensity, and
- worsened conditions for passengers

to escape in an emergency.

These problems are far worse in metro tunnels than in mainline railway tunnels, because train frequency is much higher, and the piston effect of trains moving air through the tunnels and into the stations. Other factors come into play on metros such as temperature and altitude differences, and the behaviour of trains as they move between sections of tunnel and stations.

There are five distinct operations in tunnel cleaning:

- removing rubbish (paper, bottles, cans) from the track
- removing fine and coarse dust from the track
- removing dust stuck to the tunnel walls
- removing fine dust from walls,

emergency walkways, handrails, electric panels, and signs, and

- low pressure and low water volume washing of tunnel walls.

Up to now, these processes have never been conducted simultaneously and machines are built ad hoc for each customer. In addition, special filters are needed to separate air from dust during the suction process, but it is not possible to eliminate the fine dust stuck to tunnel walls and emergency walkways. Normally, suction operations are followed by washing of walls. Tunnel cleaning has to be repeated several times a year.

Research by Tecnofer, Italy, into how tunnel cleaning could be improved led to the development of a tunnel-cleaning system that has already been used in some tunnels belonging to Italian Railway Network (RFI) and on the Naples metro. The Tecnofer system takes some peculiarities into account: the chemical and physical characteristics of the dust, and its concentration on different surfaces.

Coarse dust, predominantly sand, accumulates on the track, while fine dust composed of alumina, graphite

and silicates sticks to the tunnel walls and vaults because of a strong electrostatic bond. Even if the dust:weight ratio between the track and walls is greater than 10, fine dust on tunnel walls creates a lot of problems because it is so well hidden and strongly adhered to the surfaces. Both sweeping and suction is required to remove it. Dirt on the track has a high specific weight and so, without sweeping, it is difficult to suck up.

### Alternative approach

Tecnofer's solution takes an alternative approach and has three different actions. The first involves removing macro dirt (rubbish) by using a motorised road/rail vehicle equipped with a suction system, followed by a motorised vehicle fitted with a suction system incorporating tools to reach hidden areas, and brushes which can remove dirt and dust adhered to the tunnel surfaces.

The second action comprises a three-stage tunnel washing process. This consists of a motorised road/rail vehicle to clean signs and inaccessible

areas, a special train equipped with three arms, each of which has hydraulic brushes and rollers to remove dust produced during the job on the walls, signs and part of the tunnel vault, and a wagon equipped with high-pressure water nozzles to clean tunnel vaults and electrical cables.

The third action is performed by the motorised road/rail vehicle equipped with microniser nozzles which are able to moisten the tunnel surfaces with a water-biocide substance.

Even if the technologies and tools being used are the same, metro tunnels must be cleaned more often than mainline railway tunnels because of the high train frequency and the high rate of dust generation. Also, metro passengers waiting on underground stations will have to breathe fine dust in the absence of an efficient tunnel cleaning system.

Tecnofer says that by using its system, mainline railway tunnels should only need to be cleaned every three or four years, while metro tunnels should be cleaned and disinfected three or four times a year, but the complete tunnel washing system only needs to be used once a year. **IRJ**

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