Rules of Thumb

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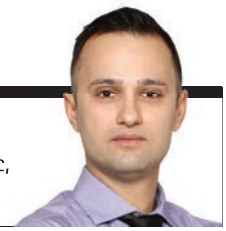

Understanding dust in tunnelling and underground projects

THE NATURAL ATMOSPHERE THAT we breathe contains not only gaseous components but also large numbers of liquid and solid particles originating from a combination of natural and industrial sources known as aerosols. Dust is the term used for the solid particles, and can be produced by different activities in underground projects, including drilling, excavation, bulk material transportation, loading and unloading, open-air storage, and movement of equipment.

The main source of dust in tunnelling is from rocks and minerals when they are broken-down and reduced to a size convenient for handling. Part of these materials are coarse enough to settle out rapidly by gravity fall. A certain percent is so fine they tend to remain suspended in air due to the combined effect of their low settling velocity and aerodynamic properties.

SIZE AND BEHAVIOR

Dusts vary widely in shape and size. The simplest method to quantify size is projected area diameter or equivalent diameter. Particles do not become visible to the naked eye until they are more than 10 microns in equivalent diameter.

Dust includes a wide range of particle sizes from over 1 mm to less than 1 µm. Particle size significantly influences their behavior: particles greater than 10 µm settle; particles between 0.1-10 µm suspend in the air but settle at a constant velocity; and particles between 0.01-0.1 µm diffuse in the air and remain in a suspended state. The most hazardous particles are those with particle sizes < 5 µm – at this size, they are small enough to be inhaled.

HAZARD POTENTIAL

Dusts can be classified based on their potential hazard to the health and safety of industrial workers. Toxic dusts cause chemical reactions in the respiratory system or allow toxins to be adsorbed into the blood stream. Carcinogenic dusts (e.g., wood, diesel, and arsenic) cause a variety of cancers.

Fibrogenic dusts scar lung tissue. Silica and some silicates are among the most common and hazardous dust particles found in tunnel construction. A risk assessment should consider the presence of silica and the likely generation of its dust. Exposure to respirable crystalline silica is known to cause silicosis, a respiratory lung disease that can be fatal.

Explosive dusts consist of materials (e.g., organics, chemicals, metals) that become explosive when finely divided at high concentrations in air. Nuisance dusts cause irritation to the eyes, nose, and throat. These include salt, potash, gypsum, and limestone.

CONTROL

Possible sources of dust in tunnels should be identified and control measures implemented to eliminate or minimise the generation of dust at the source. There are five general methods to control dusts.

1. The best method for dust control is to prevent it from becoming airborne. This is not always possible, but in some cases, such as dust generated by drill and blasting, the amount of dust generated can be minimised by controlling the powder factor (amount of explosive).
2. Removal is a common practice, with many tunnelling sites having dust removal systems. Types of dust collectors include centrifugal (i.e., cyclones), filter of fabric, wet scrubbers, and electrostatic precipitators.
3. Suppression is probably the easiest and most common method used for dust control. By using water sprays, foam, or an air/water mist (atomisers), dust can be effectively controlled.
4. Isolation involves restricting blasting times. This is a common practice to help workers avoid being in contact with contaminated air.
5. Ventilation, a combination of dilution and removal, is a common method.

MEASURING

Attempting to measure dust exposure requires an understanding of the relationship between exposure, dose, and Time Weighted Average (TWA) values. Exposure is the level or concentration of an aerosol that a person is exposed to at a given time. Dose is the total accumulated exposure over a given time.

The TWA exposure can be expressed as a function of the dose:
E (TWA) = *Dose / Total Exposure Time*

Measuring dust concentration is difficult due to its dynamic nature and variability across project areas. Methods include particle counting, gravimetric, and photometric (light scattering) methods.

MASKS

Dust masks are commonly used in tunnelling where dust generating operations are underway. The following are few guidelines for the better use of dust masks:

- Always review the data safety sheets of the material to assess the type of mask appropriate for the operation.
- Dust masks are to be used for airborne particulates only and are not suitable for hazardous vapors.
- Change dust masks frequently and or when noting a discoloration from the accumulation of particulates.
- Ensure that masks fit snugly. If you feel air leaking around the edges, adjust or switch to a different mask.
- Beards may interfere with the proper fit, so other options may be necessary

Tunnelling projects worldwide continue to increase productivity as equipment and practices improve. Unfortunately, this also results in the potential for increased dust generation and worker exposure. In response we need to apply best controls available while looking for innovations to better control dust levels.

Agree or disagree?

Let us know what your experience has taught you. Or let us know what topic should be included in future *Rules of Thumb* columns. *editor@tunnelsandtunnelling.com*