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Monitoring Fugitive Dust

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- Fugitive Dust
- Particulate
- Remediation
- Worker Saftey
- Exposure

Introduction

The term fugitive dust refers to particulate that is lifted into the air either by man-made or natural activities in large open areas. Fugitive dust is typically the result from activities such as the physical movement of soil, vehicles traveling over unpaved surfaces, heavy equipment operation, blasting, and wind. Aerosolized dirt on road construction sites is a common contributor, as is agricultural equipment moving on unpaved roads or parched soils. The storage and movement of aggregate piles also produce fugitive dust, more commonly known as dust bowl conditions. Particulate resulting from combustion (motor vehicles and other internal combustion engines) and transformation operations such as soldering, brazing or welding are typically excluded from the general definition of fugitive dust.

This release into the atmosphere does not happen in a controlled manner nor does it necessarily originate from a known source point. While various environmental regulatory groups establish definitions for source of dust and maximum exposure levels, it is difficult to know if your dust control plan is effective. A means of quickly identifying if your site is exceeding the exposure limits is critical to maintaining compliance.

History

The Clean Air Act (CAA) of 1970 established National Ambient Air Quality Standard (NAAQS) for a number of hazardous pollutants. One of those hazardous pollutants identified in this overarching document was particulate matter or PM.

The first regulation for PM was released in April 1971 and called for the measurement of total suspended particulate (TSP) in the range of 25 – 45 microns (µm). Exposure limits were based on a mass concentration (weight) for both a 24-hour average exposure limit (260 µg/m3) and an annual geometric mean (75 µg/m3).

Over the next four decades, these exposure values were reassessed and reduced, in both total permissible exposure and particulate size. PM-2.5, or particulate matter that is up to 2.5 µm in size, has become the "standard" as material up to this size have the most detrimental impact on health. For most fugitive dust applications, measurements for PM-10 are still the most common due to other detrimental effects.

A series of state and local air monitoring systems (SLAMS) provide data to the EPA's Office of Air and Radiation's (OAR) Aerometric Information Retrieval System (AIRS) database to ensure compliance with the NAAQS.

While fugitive dust is not a direct part of the NAAQS, these emissions do contribute heavily to the overall particulate measurement and the exposure limits. Emissions are usually controlled by the local regulatory authority such as state EPA or DEQE, air quality management districts, air resource boards or special program agencies. Permissible levels of exposure and enforcement vary widely. Most regions have established exposure limits on projects that typically result in high level of particulate generation and the exposure limits are written into the operating permit.

The operating permits vary by the type of projects, such as construction, remediation and demolition, and dust exposure is often permitted at a higher level than the NAAQS due to the nature of the work. Once the limit is approached, control of the dust emissions can be reached through a number of local containment efforts. Temporary measures range from water sprays and cover materials to reduce the airborne dust while active work is being performed. As the project approaches completion, more permanent measures such as landscaping and or paving can be employed to reduce emission to normal ambient levels.

One example of a special program agency and program is the

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New York State Department of Environment Conservation (DEC) technical guidance document DER-10 for site investigation and remediation. A copy of the DER-10 may be found at *www.dec.ny.gov/docs/remediation_hudson_pdf/der10.pdf*. This is not intended for worker safety (respiratory concerns), but rather protects areas outside of the active work zone. It provides guidance on monitoring protocols to prevent the exposure outside of the work area. A second appendix (1B) provides guidance for fugitive dust and particulate monitoring as well as dust control techniques. Among the critical parameters are the need for real time readings, wide measurement ranges, data logging and visible alarms.

The reason real time monitoring is required is that condition at an active work site can change quickly, as new sections are opened and dirt moving operations are in place. (See reference A). While the DER-10 applies only to New York State work sites, it does provide overall guidance to effective monitoring practices and is reflective of regulations / guidelines used throughout the United States. Similar practices are often utilized outside of the United States as well.

The impact of fugitive dust results is not restricted to the nuisance problems noted earlier. In areas of high concentrations, visibility is reduced which can lead to traffic accidents. Valuable farm top soil can be carried by winds, leading to poor crop yields. The impact on the health of personnel in contact with the fugitive dust conditions on both workers and residents can be severe.

The majority of PM-10 particles in the environment are caused by fugitive dust. If the dust is “clean” the inhaled particles can lead to asthma and other breathing problems. However, if the particles carry chemicals (rubber from tires), heavy metals (lead from sandblasting operations) or other hazardous substances (asbestos from demolition or silica from mining operations) the lungs can be permanently damaged.

Thermo Scientific Solution

Monitoring for fugitive dust exposure requires instrumentation that provides a quick response, is dependable, can be quickly deployed or relocated and has the performance capabilities stated in the governing guidelines or within the site permit.

For quick response, a light scattering device (nephelometer) provides the real time measurements required to take immediate corrective actions for the excursion above the exposure limit. If selecting this technology, you must ensure it also provides the additional capabilities often associated with the guidelines.

Since the concentrations will likely vary depending on the activities being performed, a wide measurement range is usually required to be able to capture heavy concentrations. In addition, constant high concentrations can result in very high dust loading on filter-based nephelometers, which can cause the particulate sizing controls (cyclone or impactors) to not performed properly due to reduce flow. Lastly, as work areas of this type are usually very fluid with respect to specific areas being monitored, an instrument that provides quick set up and the ability to withstand the normal monitoring conditions (hear, rain, wind) should be selected

The Thermo Scientific ADR-1500 Area Dust monitor was designed for fugitive dust applications, providing a self contained system that is enclosed in IP65 weather proof case. The ADR-1500 monitor is lightweight and can be carry by the handle and mounted on walls, posts or an industrial tripod. It can be operated from external AC or DC power, and an internal 12 volt lead acid battery provides up to 100 hours of operation. The unit employs sensors for pressure, flow temperate and humidity, enabling it to provide true volumetric flow control. The benefit of this feature is that the instrument maintains the correct flow rate, which assured the cut point of the cyclones remains consistent. To assist with heavy particulate loading, the unit has a large HEPA filter that permits the unit to accept high concentrations, meaning long periods of unattended monitoring. It offers the widest measurement range of any deployable particulate monitor and the integrated heater assures you are measuring dust, not condensing moisture.

An optional filter cassette holder allows collection of the material for post monitoring gravimetric measurement, permitting the nephelometer to more accurately reflect mass measurements. A bright beacon will provide quick identification of alarms and the internal data logging provides sufficient memory for several months of monitoring results.

We also provide similar capabilities in a wearable portable device to help identify areas of high concentrations and protect the individuals working at the site. The Thermo Scientific pDR1500 personal Data Ram provides great utility and long operation life with commercially available batteries. It possesses many of the key features of the ADR-1500 monitor (volumetric flow control, wide concentration range and a 37mm filter for post monitoring analysis). The unit may also be used for any NIOSH method 0500 or 0600 monitoring applications. The small size permit workers to wear this and provides instantaneous feedback on exposure levels. Workers are able to quickly respond to the elevated levels, moving themselves out of harm’s way and taking action to mitigate the condition.

For even greater accuracy, our unique combination of a beta gauge and nephelometer used in the Thermo Scientific SHARP 5030i monitor can assist you by providing the speed of light scattering with the precision and accuracy of beta attenuation. This is an installed monitor that can provide higher precision and accuracy for longer term operations. The long life filter tape automatically advances based on time or particulate loading resulting in low maintenance. The integral Intelligent Moisture System regulates the heating of the sample to maintain a temperature slightly above the dew point. The SHARP 5030i monitor is also an US EPA PM-2.5 Equivalent Monitoring, which permits use for compliance monitoring.

For critical applications, use of a SHARP 5030i monitor with several ADR-1500 units would permit effective perimeter monitoring and the ability to determine where the heavy particulate is originating. The triangulated ADR-1500 units would provide data on the source of the dust (location and time of elevated readings) at a reasonable cost, and the SHARP provides the low end sensitivity to assure compliance with the applicable regulations.

Summary

Fugitive dust will continue to be hazardous to both personal health and the environment due to the necessary processes that result in the creation. Different sites require different solutions, but the ability to quickly identify the concentration and possible sources of the dust is critical to achieving compliance. Thermo Fisher Scientific offers a wide range of monitoring solutions, technical expertise and support to help you resolve these issues.

Summary of National Ambient Air Quality Stardard Promulgated for Particulate Matter 1971 - 2006

Final Rule	Indicator	Avg Time	Level	Form
1971 (36 FR 8186)	TSP - Total Suspended Particulate (≤25 - 45 µm)	24 Hour	260 µg/m^3 (primary)	Not to be exceeded more than once per year
			150 µg/m^3 (secondary)	
		Annual	150 µg/m^3 (secondary)	Annual average
1987 (52 FR 24634)	PM_{10}	24 Hour	150 µg/m^3 (primary)	Not to be exceeded more than once per year on average over a 3 year period
		Annual	50 µg/m^3 (secondary)	Annual arithemtic mean, average over 3 years
1997 (62 FR 38652)	$PM_{2.5}$	24 hour	65 µg/m^3	98th percentile, averaged over 3 years
		Annual	15 µg/m^3	Annual arithemtic mean, average over 3 years
	PM_{10}	24 hour	150 µg/m^3	Initiallypromulgated 99th percentile averaged over 3 years; when 1997 standards were vacated, the form of 1987 standards remained in place (not to be exceeded more than once per year on average over a 3 year period)
		Annual	50 µg/m^3	Annual arithemtic mean, average over 3 years
2006 (71 FR 61144)	$PM_{2.5}$	24 Hour	35 µg/m^3 (primary)	98th percentile, averaged over 3 years
			15 µg/m^3 (secondary)	Annual arithemtic mean, average over 3 years
	PM_{10}	Annual	150 µg/m^3 (secondary)	Not to be exceeded more than once per year on average over a 3 year period

Figure 1:
The evolution of the regulations with respect to concentrations and size categories.

In addition to this offices, Thermo Fisher Scientific maintains a network of representative organizations throughout the world.

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