NANOZETTE

The official newsletter of Nanozen Industries

IN THIS ISSUE

DUST SPECIFIC CALIBRATED REAL-TIME PARTICLE MONITORS

Accurate workplace dust exposure monitoring and control is crucial to reducing illnesses caused by industrial aerosol pollutants such as silica and coal particulates. In this article we will examine the importance of calibrating real-time dust monitors when measuring particulate matter that differs significantly from standard Arizona Road Dust (ARD). Current NIOSH findings will be reviewed, along with the results of a recent side-by-side trial of coal dust containing respirable crystalline silica (sampled from a Canadian coking coal mine). The results compare the Nanozen DustCount optical particle counter (OPC) to standard gravimetric analysis for coal mine dust. The DustCount was shown to be highly accurate in this trial.

The NIOSH Science Blog at the Centers for Disease Control and Prevention has posted opinion and some preliminary data on the use of real-time respirable dust monitors. Dr. Emanuele Cauda (NIOSH Center for Direct Reading and Sensor Technologies) and his

colleagues tested a few commercially available real-time respirable dust monitors that utilize optical techniques to count particles and convert them into mass concentration. In normal practice, these particle counters are calibrated with the common standard aerosol –Arizona Road Dust (ARD). Under many circumstances, ARD calibration is sufficiently accurate when monitoring mixed dusts and dust containing silica (including rocks, cements and sands). It is only when the optical properties or density of the dust of interest is vastly different from ARD that custom calibration is necessary.

Although manufacturers recommend calibrating their monitors to the dust of interest (if different from Arizona Road Dust), there is concern that this is not being properly carried out in practice. In the NIOSH blog, preliminary test results were shown to have correction factors ranging from 0.85 to 1.5 when the measured dust is not Arizona Road Dust. The blog authors expressed concern about the wide error range (15-50%).

Light scattering-based instruments, including photometers and optical particle counters (OPCs), are widely used for real-time particulate mass concentration measurements, and are commonly found in compact and portable personal dust monitors. Photometers (nephelometers) measure the overall scattered light from a collection of dust particles. The photometric response is then correlated to the mass concentration of sampled dust using predetermined calibration factors. OPCs, on the other hand, measure the amount of scattered light from individual dust particles to size-classify them and determine particle size distribution. Assuming known particle density, the size distribution can then be converted to mass concentration.

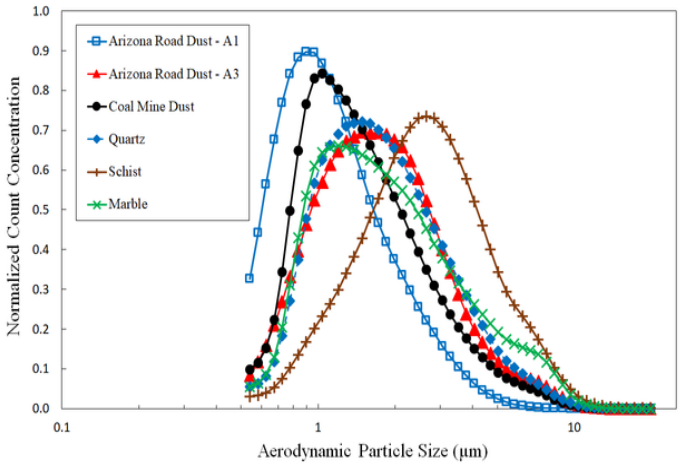

Figure 1. Particle size distributions of different mine dust samples

It is well known that the response from such light scattering-based monitors depends on particulate properties such as shape and refractive index. Thus, different calibration factors are required depending on the properties of the sampled dust. Moreover, the photometric response of photometers/nephelometers is known to be strongly dependent on particle size. Photometers typically underestimate mass concentration of coarse particles (larger than 2.5μm) and overestimate mass contributions from finer particles (smaller than 0.2μm). These biases could result in large particle concentration errors due to the high variability of aerosol concentrations and size distributions typically present in workplaces, especially as the monitor changes distance, orientation, or interference to the source of particles which causes the profile of particle sizes to change. Multiple calibration factors would be required for different size fractions (e.g. PM10, PM2.5, PM1, inhalable, thoracic, respirable, etc.) of the same aerosol type. Figure 1 above

shows the particle size distribution of various mine dust samples. Given the variation in particle size distribution, it is almost impossible to calibrate photometers accurately for every mining activity and site.

Evidently the selection of reference dust used for the calibration of real-time optical monitors has a significant impact on the accuracy of mass concentration readings. If the optical and physical properties of the dust of interest differ significantly from the calibration particle material, dust-specific calibrations against gravimetric references are required to meet desired measurement accuracy levels. Such calibration is usually conducted with direct comparison of the dust monitor to the Federal Reference Method (FRM) using gravimetric filter samplers (U.S. EPA 1997b). Once an OPC has been calibrated to the dust type, it can be used confidently with varying particle sizes and combinations of sizes for that dust. This is not true of photometers/nephelometers for reasons discussed above. Photometers must rely on a specific profile of dust sizes to be accurate and must be recalibrated whenever this profile changes.

Please refer to Figure 2. In a case study, the performance of Nanozen's DustCount monitor was evaluated for coal mine dust. Coal dust was chosen as a light-absorbing aerosol with substantially different optical properties from the standard Arizona Road Dust used as the default calibration for DustCount monitors. When the OPC-based DustCount was only calibrated with ARD, the percentage error was 87.49% when monitoring coal dust with varying percentages of respirable crystalline silica.

DustCount monitors were then calibrated with a specific coal dust sample against gravimetric filter measurements. Subsequently, a series of runs over several hours were carried out at various coal dust concentration levels and size distributions. DustCount monitor readings were simultaneously compared against a TEOM monitor (Series 1400a, Thermo Scientific). The TEOM, an EPA designated FRM-equivalent instrument, was considered as the real-time mass concentration reference along with gravimetric analysis in these tests.

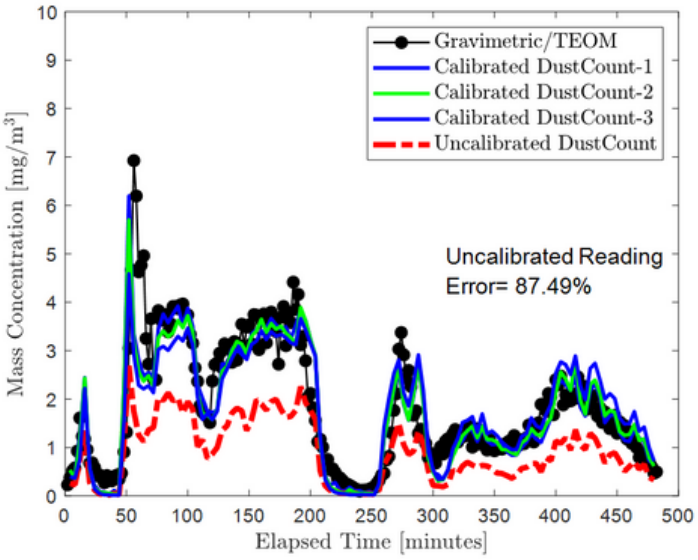

Figure 2. Comparison to Gravimetric/TEOM time series

Figure 2 shows coal dust mass concentration measured by three DustCount monitors compared with gravimetric/TEOM results. It can be observed that upon calibration with the coal dust sample, Nanozen's DustCount monitor is in close agreement (within a few percent error) with the Gravimetric/TEOM measurements over the wide range of concentrations tested.

Unlike photometers/nephelometers, optical particle counters such as Nanozen's DustCount have been shown to provide accurate real-time monitoring for a variety of dust types, provided they are calibrated appropriately for the particles of interest. OPC's can be calibrated by aerosolizing particles in a specialized analytical laboratory, or in Nanozen's case, by using the internal sampling filters included with the DustCount monitor. As well, Nanozen's Dust Count can store up to 11 different dust calibrations (ARD plus 10 others). These are easily accessed via the DustCount desktop software or the field app on a smartphone or tablet. Many mines store multiple dust types on their DustCount monitors, ensuring that all of their units can be used throughout the mine in areas with significantly different dust types (e.g. the rock face, crusher, refining plant and loading bays).

Nanozen DustCount 9000 with sampling filter enables real-time and lab-based particulate analysis

One can accurately utilize the power of real-time particle monitors to isolate pollution sources and investigate the effectiveness of control measures. Timely, accurate monitoring can potentially reduce or eliminate silicosis and black lung for workers in mining and related industries. With the convenience of multiple stored calibrations, Nanozen's DustCount ensures accurate readings in challenging environments.

Nanozen DustCount 9000 PM 2.5 (silver), PM 4 (black) and PM 10 (gold) impactor caps

To read the complete NIOSH blog click here. To learn more about Nanozen's Intrinsic Safe DustCount monitor and their custom calibration capabilities click here.

AIOH ANNUAL CONFERENCE RECAP

The Australian Institute of Occupational Hygienists Association held their 37th annual conference in Perth Australia in early December and once again Nanozen was out in full force. As a "Sapphire" sponsor we were proud to help support such a great event.

The event was very well attended with over 500 delegates from Australia, New Zealand and the South East Pacific region along with other experts from around the world. While we enjoyed catching up with many colleagues and customers at the show, we were especially pleased with the number of new people we met at the event!

The conference's theme was "ReCalibrate | ReSynergise | ReBrand". Nanozen's DustCount fit perfectly into the AIOH Recalibrate theme which centered around embracing new technologies, adapting to new opportunities and stretching traditional boundaries.

Our DustCount 8866 FireSmoke Edition, 8899 and 9000 were on display in the Nanozen booth and our partner Breathe-safe was also showcasing our DustCount 8899 in their booth. We look forward to sponsoring AIOH again this year which will be held in Adelaide in late November.

PARTNER SPOTLIGHT - BREATH-SAFE

Breathe-safe is an Australian distributor of Nanozen products with offices in Brisbane and Perth, and business throughout Australia. In addition to reselling Nanozen products, the company also manufactures, sells, and supports a line of filtrations systems for industrial use in mining, quarrying, and construction.

As a trusted supplier to Australia's largest mining companies, Breathe-safe helps Nanozen deliver and support our products in the region. Nanozen and Breathe-safe plan to expand their relationship in 2020 by adding an Australian calibration lab eliminating the need for DustCount monitors to be shipped back to North America annually for calibration and cleaning.

Breathe-safe's high-efficiency filtration and pressurization systems can be fitted to mining equipment to protect workers from a variety of risks including respirable asbestos fibers, crystalline silica dust, pesticides, mineral fibers and diesel particulate matter (DPM). To show the effectiveness of their filtration system products Breathe-safe utilizes Nanozen dust monitors.

Nanozen DustCount proves Breathe-safes effective air cleaning capability (left). Breathe-safe is deployed successfully in heavy equipment in mining, quarrying, and construction (right)

STONE COUNTERTOP FABRICATION AND THE GROWING SILICOSIS RISKS

Workers at stone countertop fabrication companies commonly perform tasks such as grinding, dry cutting and polishing large slabs of granite, quartzite, sandstone and engineered stone which can contain more than 90% crystalline silica. Without proper controls and personal protection equipment these workers are at significant risk of developing silicosis. In fact, California's Department of Public Health (CDPH) has recently issued an occupational health alert highlighting 18 cases of silicosis in 4 states including 2 deaths.

The CDPH's Occupational Health Branch of reported that 2 workers, aged 36 and 38 died from severe silicosis, an incurable lung disease in 2018. 43 additional employees from the same company were tested and roughly 12% were found to suffer from silicosis. Stone fabricators in Colorado, Texas and Washington state have been diagnosed with silicosis and while this is the first major cluster of silicosis reported among stone fabrication workers in the US, outbreaks in Israel, Spain, Australia and China have previously been reported.

Studies have shown that silica exposure in many of these companies is much higher than allowed under the new federal Occupational Safety and Health Administration (OSHA) silica standard.

Clearly additional controls, education and monitoring tools specific to this industry are required, and we applaud the CDPH's efforts to identify this at-risk population, and for their creation of a "Silica Safety Resources for Stone Fabricators" landing page which collects relevant resources from OSHA, NIOSH and the CDC in a single place.

To learn more about the CDPH's new initiative and other related information sources, feel free to email us at moreinfo@nanozen.com and we will happily provide you some additional links.

UPCOMING EVENTS

March 13, 2020
Burnaby, BC, Canada

We are proud to be a Gold Exhibitor at the BC / Yukon AIHA chapter's Annual General Meeting. If you are attending the event please stop by and see our new intrinsically safe DustCount® 9000. Also be sure to catch Nanozen CEO Peter Briscoe's presentation at 2:15 pm!

March 18/19, 2020
Edmonton, AB, Canada

We are also proud to be a Silver Sponsor of the Alberta AIHA chapter's Annual General Meeting. Dr. Winnie Chu, Nanozen's CTO and Founder will be giving 2 presentations at the event and our new Vice President of Sales Hayley Croteau will also be attending. Make sure to stop in and say hi!

April 6-8, 2020
Duluth, MN, USA

Dr. Chu will also be presenting at the Society for Mining, Metallurgy & Exploration Inc. (SME) conference in Duluth Minnesota on Wednesday April 8. Winnie's presentation "Getting Hygienists a Seat at the Table" will be delivered as part of the technical program and begins at 9:30 am.

April 14, 2020
Austin, TX, USA

Catch us at the EHS & Risk Technology Summit in April. The event is hosted by the ASSP Central Texas Chapter, the RIMS Central Texas Chapter, and the Texas Hill Country AIHA Local Section, in partnership with The University of Texas. Nanozen is a "Summit Supporter" and Hayley would love to meet you there.

June 1-3, 2020
Atlanta, GA, USA

Finally dont miss us at the AIHce 2020 in Atlanta on June 1-3. Stop by booth 1704 to hear about the latest developments at Nanozen or catch Peter's Learning Pavillion presentation from 12:50 - 1:15 pm on Tuesday June 2.

LET'S KEEP IN TOUCH!

We hope you enjoyed this issue of Nanozette. Please let us know how we can improve this newsletter and make it even more relevant to your interests and needs. And of course please feel free to pass along to your colleagues! Also if you want all the breaking news, consider following us on LinkedIn and Twitter. If you would like to unsubscribe, we are sorry to see you go but simply click the unsubscribe link in the newsletter email.

nanozen
know the air you breathe®

INTRINSIC SAFE

INCREASE AWARENESS OF SILICOSIS AND BLACK LUNG DISEASE RISKS FOR MINERS

SILICOSIS AND BLACK LUNG ARE OCCUPATIONAL LUNG DISEASES THAT AFFLICT MINERS WORLDWIDE. DANGEROUS LEVELS OF SILICA AND COAL DUST ARE GENERATED IN UNEXPECTED PLACES AT MINE SITES

Nanozen's DustCount®, the industry's smallest and lightest optical particle counter, offers accurate real-time personal dust monitoring which helps protect miners from the hidden risks of crystaline silica and coal dust exposure. With realtime exposure alarms and built-in sampling filter/FTIR support for rapid gravimetric results, Nanozen's DustCount offers unparalleled monitoring capabilities for mines and miners.
Learn more at www.nanozen.com/mining

- PM 2.5, PM 4, PM 10 & Inhalable
- Easy input of custom silica percentage
- Built-in sampling filter
- Selectable/custom dust types
- FTIR and NIOSH FAST support
- Data logger for custom post sampling analysis and comparative studies
- No cyclone required
- Integrated wireless control/data

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