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Synergist® Solutions: Dust Monitoring

A New Approach to Dust Monitoring

By Peter Briscoe

A new approach to dust monitoring is starting to spread throughout the industrial hygiene field. It relates to the application of compact wearable products that simultaneously combine real-time direct dust count readings with traditional filter-based sample collections for composite analysis in the lab.

One example of this approach is the Nanozen DustCount 8899 real-time personal wearable dust monitor product (see Figure 1). This real-time optical particle counter and mass concentration reading device also collects a specimen for post-event analysis.

Figure 1

There are four critical advantages to applying this technological approach:

1. A worker has to wear only one compact, lightweight device to conduct both methods of monitoring: real-time and sampling.
2. Since all monitoring is conducted in one pass, a hygienist doesn't have to spend the time, money, and effort to separately deploy someone with a portable meter for real-time monitoring.
3. Given that dust sampled from the breathing zone is simultaneously used for both real-time monitoring and standard method sample collection, 100 percent correlation of results is guaranteed because it is the same dust. Using pumps and real-time devices separately, on the other hand, introduces the risk of questionable variance in results.

4. The real-time results fed via wireless to a PC can instantaneously identify sources of concern for the workers during a shift. Hygienists can further outfit their workers with compact video cameras to visually pinpoint and correlate geographic locations of trouble spots with the real-time dust monitoring data.

Industry Example

A facility uses raw silica that comes in bags to make specialty glass products in a forge. The silica is stored in a silo on the roof, and gravity is used to fill bags for each day's operation.

For workplace assessment purposes, the worker in the silica bagging area and the worker in the glass manufacturing area wear the device for their full 8-hour shift.

Monitoring Procedure

At the start of the day, the industrial hygienist prepares for testing by connecting the two devices to be used to her PC and setting up the test parameters (Figure 2).

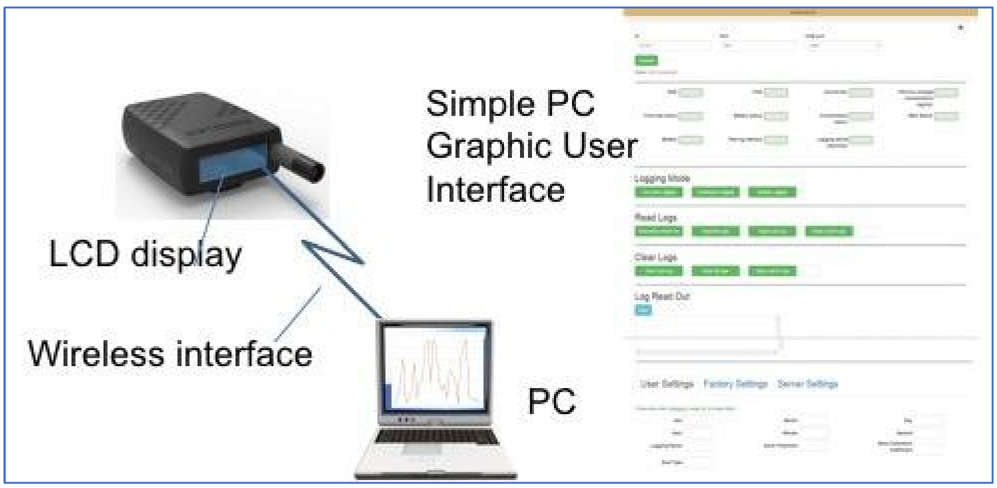

Figure 2

The IH then purges and zeroes the unit with a HEPA filter before putting in the pre-weighed cassette with the standard 25mm sample filter (Figure 3).

Figure 3

Then the IH puts the units on each worker's belt. She runs the tube to the breathing zone and clips it within eight inches of the worker's mouth (Figure 4).

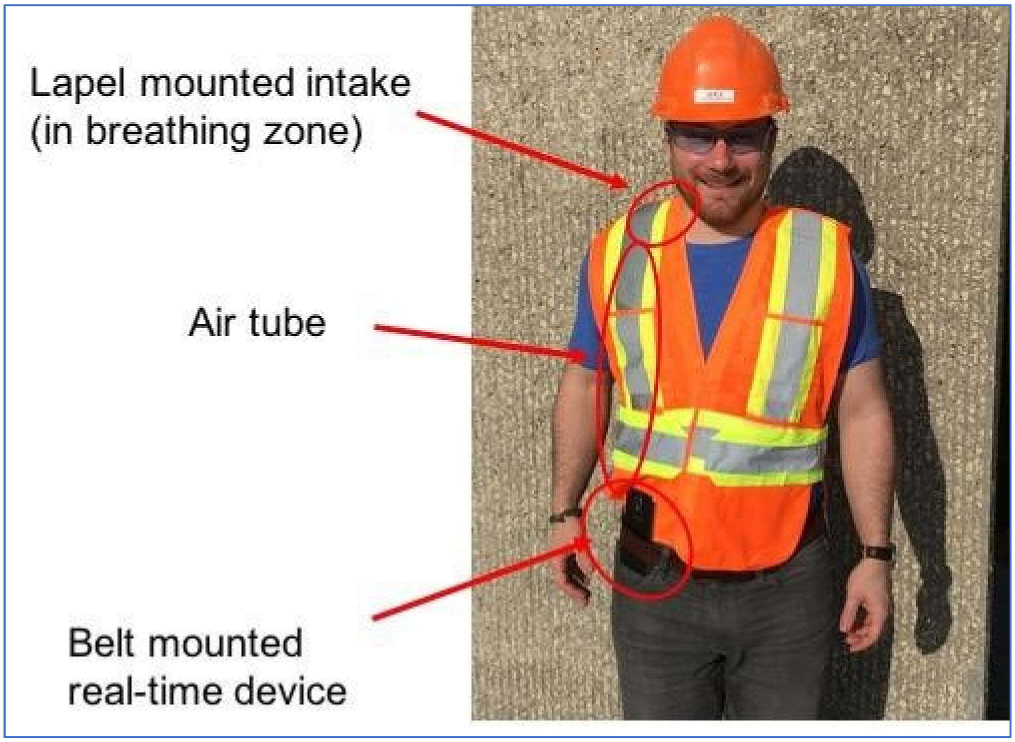

Figure 4

The workers go to their shift locations and the IH goes back to her PC, starting the test and checking to see that the data is coming from the units.

Throughout the day, the workers will hear or see an alarm if a dangerous condition occurs, or if the device has any issues. The IH will also see the alarm on the screen. A real-time graph on the IH's PC shows the progress of the testing and allows the IH to act if the situation is dangerous. Figure 5 illustrates how this system works.

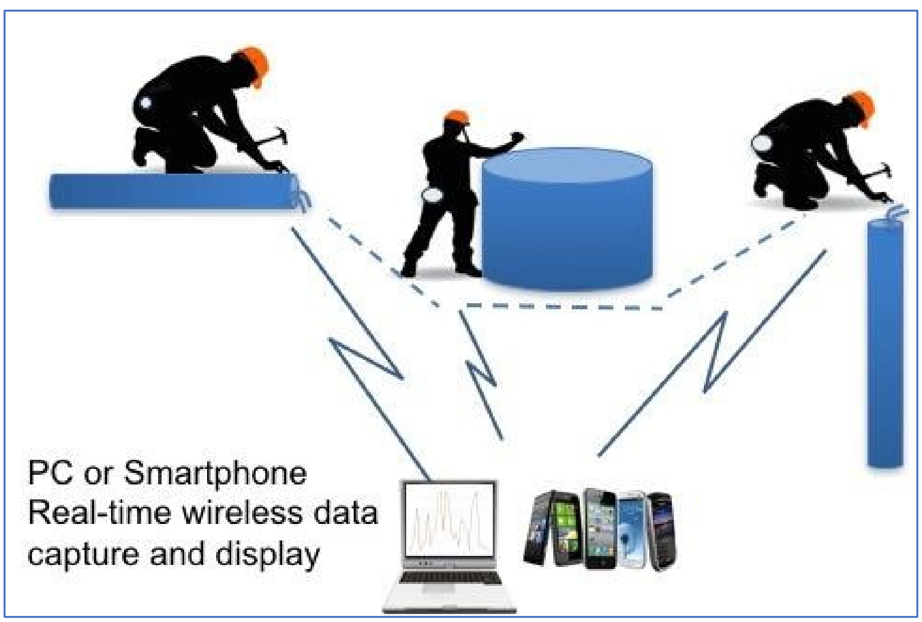

Figure 5

At the end of the shift, the test automatically shuts off. The IH retrieves units from the workers, shuts them off, removes the sample cassettes, and bags them for shipment to the lab for analysis (Figure 6).

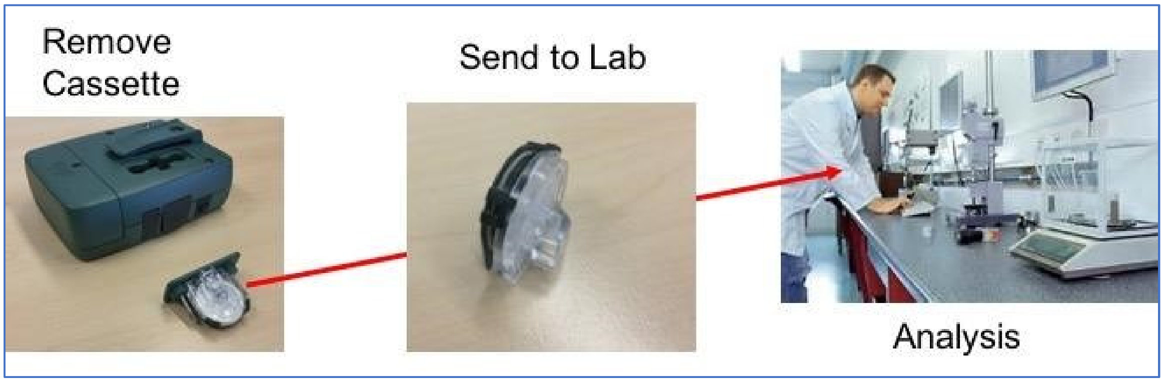

Figure 6

Real-Time Data Analysis

In the glass factory, workers are moving around and potentially encountering various danger zones. The IH sees the real-time cumulative concentration starting at zero in the lower left-hand corner and increasing to a higher level in the upper right-hand corner (Figure 7).

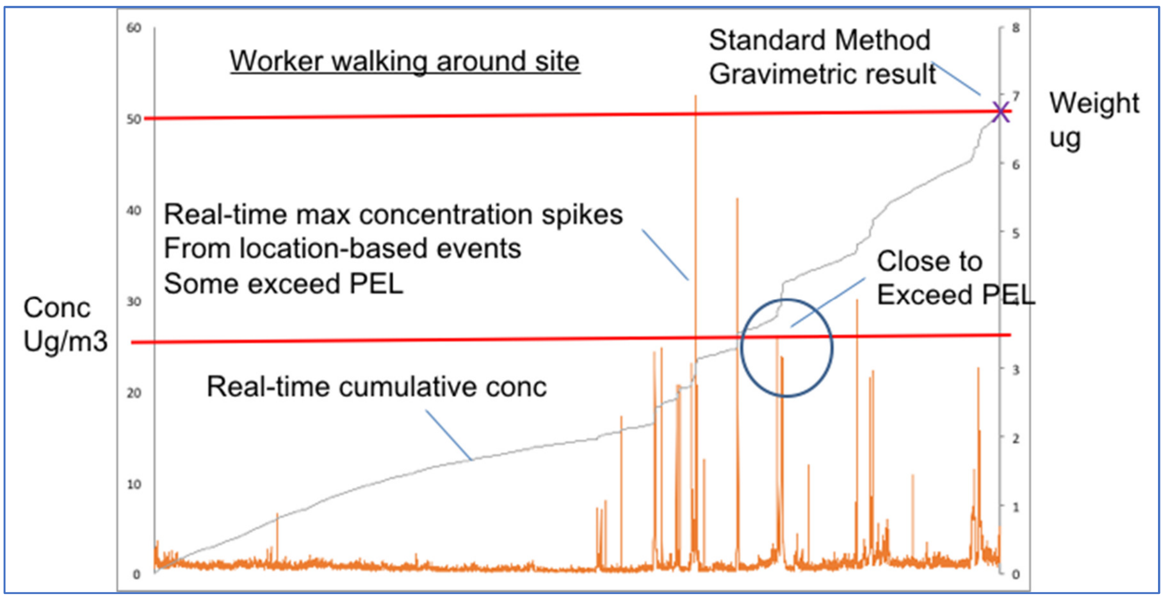

Figure 7

In this case the sample cassette was sent to the lab for gravimetric analysis (NIOSH 0600). Note the good correlation between the real-time device and the gravimetric sample analysis in Figure 7 and the visible dust on the filter in Figure 8.

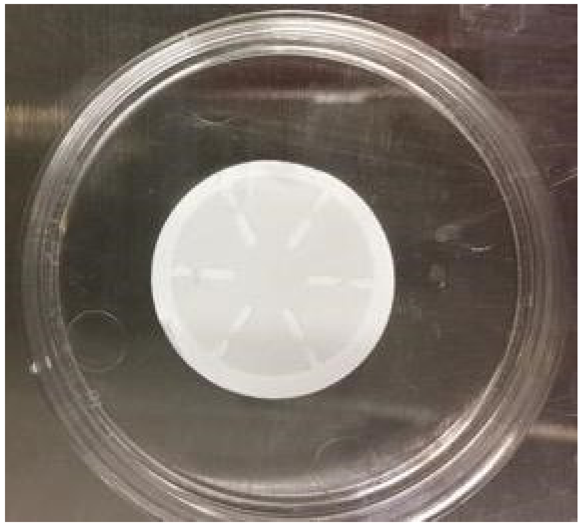

Figure 8

In Figure 7, the real-time readings across the bottom show spikes where dust concentration increases rapidly due to some event or strong source of dust. Typical events include pouring raw silica into a crucible or molten glass into a mold, releasing the raw product from the mold, coarse-sanding the raw product, or sanding and polishing during the finishing process.

The IH correlates spikes to specific areas in the manufacturing plant. Now that the levels and locations of the spikes are known, suitable containment can be designed. Note that the factory has set its alarm limits lower than the PEL. They design their containment to meet those limits.

The circled area in Figure 7 indicates that the exposure is close to exceeding the permissible level, so containment may or may not be required. With digital data, it is possible to investigate specific instances and investigate them more closely, as shown in Figure 9. Zooming in on the data shows that the spike just exceeds the limit. Further analysis is warranted before a million-dollar containment system is purchased.

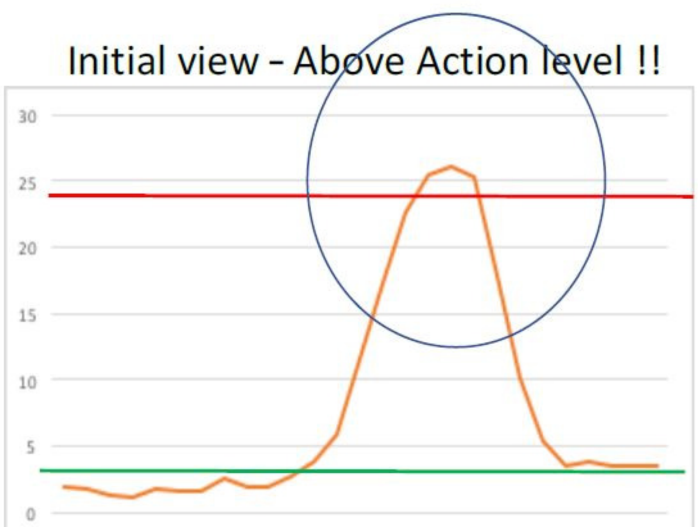

Figure 9

Further Analysis

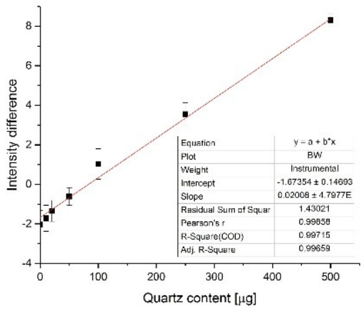

Figure 10 XRD (NIOSH 7500)

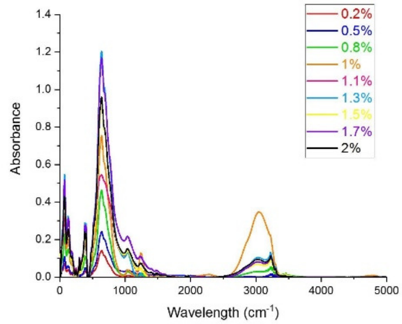

Figure 11 IR Absorption (NIOSH 7603)

The next step is to determine the percentage of the dust that is of interest in the sample and then adjust the direct-reading device to make it more accurate. For example, if the sample contains 56 percent crystalline silica, the user can adjust the device to show only 56 percent of the dust found. Using this factor, the spike under question would fall well below the limit for taking action and a containment system is unwarranted, with significant savings for the factory.

Silica Bagging

The results of the silica bagging operation show that bagging is performed near the end of the shift to prepare for the next day's operation. Two spikes from silica pours show up in the afternoon (Figure 12).

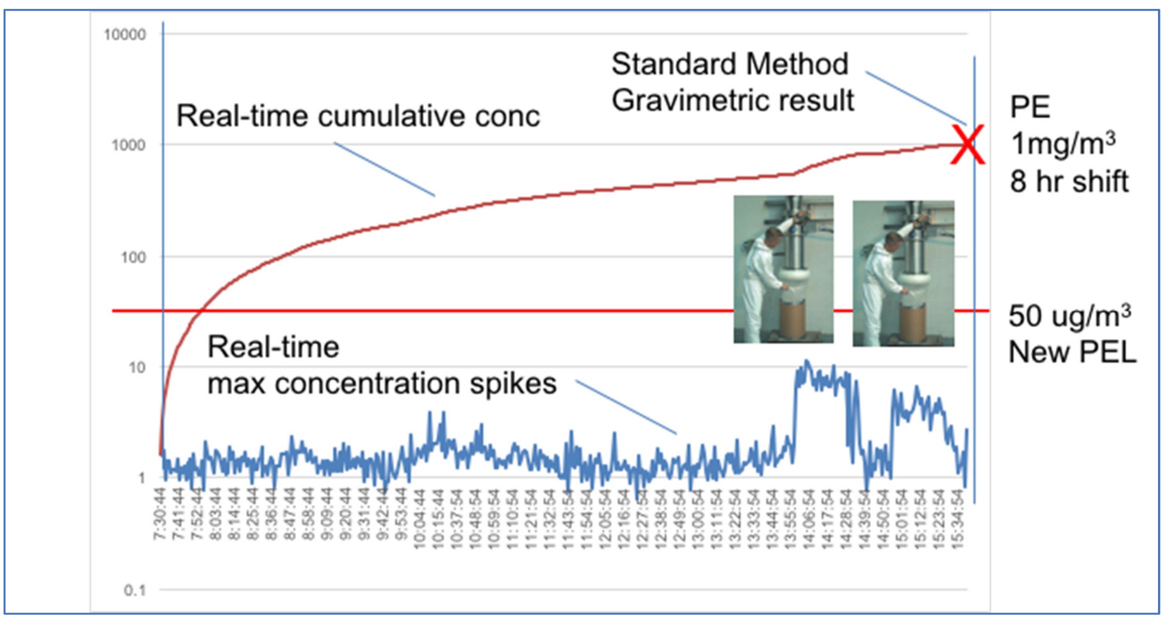

Figure 12

This part of the operation is considered highly dangerous, and workers must wear suitable protection the entire time they are in the bagging rooms. The results from this worker show the high level of silica dust ambient in the room and the even higher level during the pours.

Training

The real-time direct-reading devices have one additional benefit. When training workers, it is powerful to show them the spikes on the graph, in real-time, when they enter dangerous areas. That provides a lasting impression that helps teach them to be careful.

Benefits of Direct-reading Instruments

The combination of a real-time particle counter with mass concentration reading and a sample filter gives the industrial hygienist a bridge from yesterday's standard method to tomorrow's real-time direct-reading instruments. This provides proof of correlation, which creates comfort and confidence in using the real-time devices.

The use of real-time devices provides direct correlation between events and dust levels, as well as correlation between hazardous locations and dust levels to help locate and pinpoint areas of concern. The correlated data allows the hygienist to make decisions and recommendations on containment systems that could cost millions of dollars.

The lightweight and compact size of the device makes the worker much more at ease with wearing it.

The real-time alarms allow workers to work without protective equipment when it isn't necessary and to don their protective equipment only when dangerous dust conditions occur.

Experience has shown that the ability to see results in real time, and as a graphical representation of dangers and risks, is a strong motivator for teaching workers to use protective equipment.

Finally, the most important aspect of using the direct-reading devices along with the standard method is that the IH manager has lots of data to use when demonstrating dangers, getting senior management to focus on solving an issue, and building a case for the exact solution and investment required.

Peter Briscoe is CEO of Nanozen Industries Inc. Nanozen pioneers innovative approaches to aerosol exposure analysis for industrial workplace environments. Nanozen's mission is to manufacture and market leading edge technologies that will help drive new, emerging standards for workplace analysis, worker protection, and timely corrective action in the occupational health and safety industry.