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know the air you breathe

The new state of the art in dust particle detection.
High accuracy. Real-time, Easy to use.

Accurate Particle Monitors

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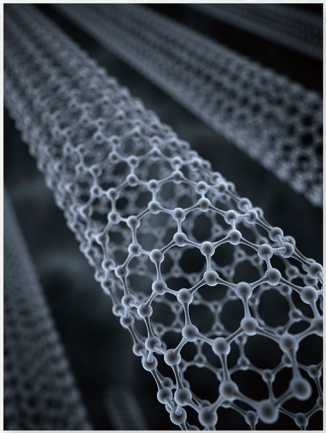
1. INTRODUCTION

Fast and reliable testing for the presence of airborne particles in the environment is vital for the protection of human health. Exposure to particles increases human mortality and morbidity from respiratory and cardiopulmonary disease. In December 2014, evidence was found confirming the expression of DNA changes from a two-hour short-term exposure to diesel particulate matters (DPM) [1]. Diesel particulate matters are part of a long list of aerosol hazards that workers may come in contact with and therefore the subject of regulations and routine monitoring. Industrial hygienists have been using currently available sampling and monitoring equipment's to detect aerosols aiming to prevent and protect worker's potential exposure to this tiny particles of significant inhalation hazards.



So far the tools to monitor these fine and ultra-fine particle hazards have been ineffective due to the state of the technology, which limit industrial hygienist's ability to pinpoint pollution sources and assess workers' exposure accurately. Increased ventilation may be initiated to accommodate high particle readings, however, if the concentration detected is higher than the actual workplace concentration, this unnecessary corrective action causes wasteful energy and operational costs. More importantly, if the particle concentration detected underestimates the actual concentrations, workers are misguided with a false sense of security and continued being exposed to airborne hazards of elevated levels. This ineffectiveness of particle monitoring tools has prevented widespread adoption of particle detection as a preventative tool for Health and Safety.

Moreover, recent engineered nanoparticles are designed to have very specific surface characteristics, such as the ability to react with or adsorb contaminants in the environment or carry drugs across the blood-brain barrier. However, the toxicological profile of these engineered nanoparticles is not well understood. Recent research has suggested that the reduced size of such particles may lead to increased toxicity [2]. The challenge for the particle detector industry is to give its customers the tools that they need with the right accuracy and features in order to provide an effective way to explore and manage particles in the air.

2. Particle Risks

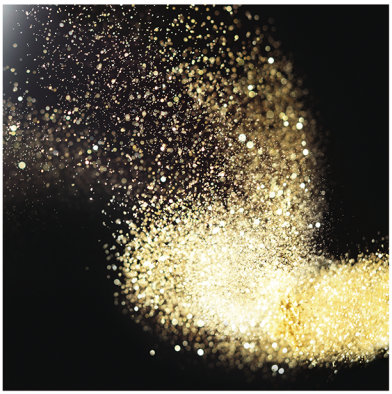
Particles are generated in the air by many of the procedures used in processing and manufacturing of wood, metal, plastic, grains, food, pharmaceuticals, rubber, cement, and many other materials.

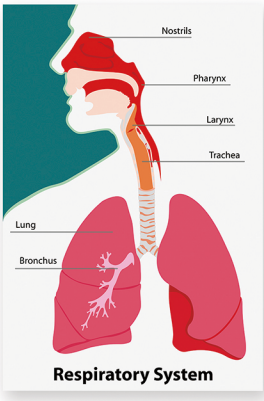
Examples of Particles are shown in the following Table.

Category of Particle	Type of particle	Size of particle	Related danger
Coarse	Sand	500um to 1000um	irritation in nose
	Sawdust	100um to 500um	irritation in nose
Fine	flour, sugar dust	75um	explosive
	Metal dust	35um	explosive, irritation
	Coal dust, fine sand	2um	respiratory, explosive
	Fine sawdust	1.5um	respiratory, explosive
	Cement dust	1.2um	respiratory
Ultra fine particles	Diesel Soot, metal dust	1um to .1um	respiratory, explosive

Inhalable and Respirable Particles

Airborne pollutants can be solid or liquid particles suspended in air that enter our bodies when we breathe. How particles exert a toxic effect is not well understood, although, where the particles deposit themselves within the respiratory system defines their toxicity. Particles less than 5 um, including ultrafine and nano-sized particles, are primarily deposited in the alveolar region, where gas exchange occurs.





Combustible Dusts

For hundreds of years factories that process materials have been at risk of explosions from the fine particles given off in the manufacturing process. The first recorded instance of this was in Turin Italy in 1785 where a lamp ignited flour dust in a bakery storeroom which exploded.
Since 1980 in the US alone there has been 500 dust related fires and explosions that have injured 900 people and killed 150.

(Combustible dust explosion)

China is now the worlds manufacturing country and this is leading to similar problems.
Recently (Aug 2012) in China at a polishing plant an explosion killed 13 and injured 14.

3. Today's Particle Detectors

In the US, Occupational Health and Safety Adminstration (OHSA) has established a standard measurement method for inhalable and respirable particles based on its mass concentration. This method involves drawing a known volume of airborne dust through a filter and weighing the quantity collected in a controlled laboratory setting. Although many exposure and epidemiological studies have relied on this method, and this gravimetric method can be used as personal exposure assessment, the delay in obtaining crucial particle concentration information makes it unsuitable as a personal warning device to alert workers or safety managers to take the necessary precautions when their local environment is polluted. Real-time tools are commercially available today to measure airborne particles and can be broken down into 2 categories: Accurate Research Instrumentation and Portable Testers.

Accurate Research Instrumentation uses sophisticated optical, detection and software package to enhance the sizing of small particles thereby increasing the aerodynamic size resolution. However, this bench top instrumentation does not offer the practical applications that a hygienist needs to conduct frequent and full work site assessment conveniently. There are many portable particle testers on the market today. Most are based on optical detection of particles through reflection or scattering. These testers suffer from poor accuracy (+- 30%) due to the inherent limitation of their optical detection. They still do not offer the true wearability that industrial hygienists require to ensure minimal distraction to workers to properly assess the personal particle exposure.

In the Combustible Dust management field, accuracy is critical. An inaccurate device could cause a plant shutdown costing millions of dollars for an inaccurate reading. This has lead to factories not even bothering to purchase these units as they can not trust them. Furthermore in order to ensure clean air in the face of poor testers factories and mines and mills just operate their Ventilation systems at maximum, wasting huge amounts of energy, especially in the winter time. Clearly, there is a need for a light-weight, accurate particle monitors to enable industrial hygienists to properly protect their workers.

4. The Ideal Detector

Industry needs an accurate detector that will allow close monitoring of workplace air for particles all of the time in order to allow it to react quickly to any problems and keep workers safe.

The keys are:

1. Accurate Device (+-5%)
2. Real–time measurements – allows immediate and decisive action
3. Small lightweight detector – allows a portable or wearable device
4. Spatial information – allows a space-time map of the working premises

Accuracy

Accuracy is critical for industrial applications. Occupational Health Regulators should act as the reference body similar to the Environmental Protection Agency (EPA) in the USA or ISO to set particle counting standards and enforce the regulations.

Real-time Results

For worker health and for combustible dust management it is critical to get readings immediately and often to determine if a dangerous condition is developing or exists.

Small Lightweight

If workers are expected to wear the detectors on their shift the detector must be small enough to be clipped to their helmet or safety vest.
If a municipality wants to deploy a large number of these they do not want to have to build enclosures or put up posts.

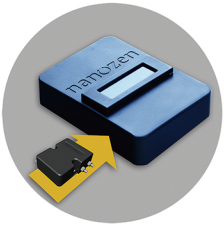
Spatial Information

Accurate, lightweight sensors provide the possibility of many sensors being deployed over a wide area. This wireless, GPS enabled spatial information along with real-time accurate particle counts will allow build a 3-D view of a workplace and give a much better understanding of the environment and how it is dynamically changing in real-time and allow instant response or remedial action.

5. Nanozen's new DustCount Particle Detector Family

Nanozen founder Dr Winnie Chu is an expert in particle sensors and dust analysis. With a PHD in chemistry and masters in quantum mechanics Dr Chu understands the physics and chemistry of particle disruption and the effects on the human body. Dr Chu also understands the pain of the industry, having ran the particle analysis lab at UBC and participated in any field operations to test various factories, mines, and sawmills. Dr Chu recognized the challenge for the industry and set about designing a particle detector that would provide the ideal product for the industry.

The Dustcount Product Family is the accumulation of years of research and development to create and bring such advanced design to market. The basis of the product is a new micro size technology that allows a highly accurate and real-time particle sensor to be created. This technique lends itself to mass manufacturing in order to bring down the size while maintaining the accuracy. This sensor is then used in a family of products tailored to each of the 3 major areas of particle detection, Ambient Environment, Occupational Health and Safety as well as Combustible Dusts Monitoring.



DustCount Model 8866

DustCount Model 9988

6. CONCLUSION

In this article, we have introduced the type and danger of airborne particles, we have discussed why the existing methods of detection are inadequate for industry today and why the combination of real-time and high accuracy in sensors are essential for proper protection of people when air is compromised.

We have also shown what an ideal particle detector should be and we have shown how Nanozen's particle detector technology and Products provide the answer to the challenge that faces industry today.

REFERENCES

[1] Ruiwei Jiang, Meaghan J Jones, Francesco Sava, Michael S Kobor and Christopher Carlsten Particle and Fibre Toxicology 2014, 11:71.

[2] Warheit, DB, et al. (2005) Pulm Toxicol, 229th ACS National Meeting.