OPTICAL INSTRUMENTATION
FOR MEASURING
DUST CONCENTRATION

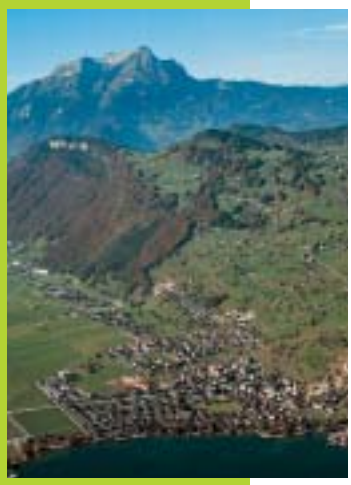
SIGRIST
PROCESS-PHOTOMETER

SIGRIST PHOTOMETERS FOR DUST DETECTION

Committed to upholding tradition

SIGRIST process instruments have been used for over 60 years for measuring the dust concentration in production processes or in the ambient air to ensure good working conditions and minimize environmental pollution. SIGRIST photometers, of course, are known the world over for their legendary accuracy and reliability. This brochure provides an overview of the various SIGRIST dust concentration instruments and their applications. Other brochures are available covering applications of SIGRIST photometers in industrial processes, in the beverages industry and in water treatment.

The company



SIGRIST is a leading manufacturer of process photometers for continuous safety, purity and quality monitoring. Whether you're talking turbidity, suspended solids, dissolved substances, color, oil or dust, we produce an instrument adapted to your particular process. With our reliable, low-maintenance sensors, we can help you guarantee quality and reduce operating costs.

The SIGRIST Group is domiciled at Ennetbürgen, Switzerland. About 60 employees work at the head office developing, producing, and selling SIGRIST photometers. Around the world, a network of over 50 representatives and service partners provides on-the-spot assistance. Wherever you are, a SIGRIST expert is never far away.

Leadership through innovation

Steady progress in sensor technology and the implementation of innovative ideas to the benefit of users mark all of SIGRIST's products. Today, modern sensors with semiconductor light sources and microprocessor controls keep this instrumentation technology reliable and practically maintenance-free. At the same time, it is usable for an ever-broader range of duties in the monitoring and control of production processes as a result of reduced capital cost with simultaneous expansion of measurement capabilities.

WHY MEASURE DUST CONCENTRATION AT ALL?

Better process economics

Product losses hurt process profitability. Optimal process control and the recovery of separated material can substantially reduce the amount of product lost in the form of dust. Examples of this are found in production plants for detergents, cigarettes and vitamin C. Dust concentration measurement is an important tool in identifying, gauging and avoiding such losses.

Reduction of pollution

As a result of steadily increasing industrialization and ever more power plants, incinerators, cars and other sources of dust, the extent of environmental dust pollution is rising just as steadily. It has been proven that the inhalation of dust, and especially fine dust, can be injurious to health and cause illnesses. For this reason, the industrialized countries have imposed concentration limits with the aim of reducing dust emission levels.

Naturally this applies especially to the monitoring of work areas in very dusty production processes. It becomes even more important, and in fact mandatory, where certain dusts are toxic (such as lead dust). In these cases the individual workplaces or production rooms must be monitored.

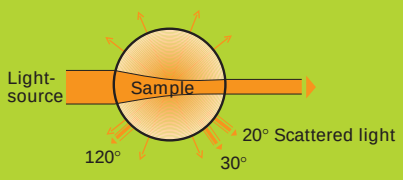
Fire detection

The capability to detect and extinguish incipient fires plays an important role in increasing the safety of road and railway tunnels and subway stations. Detecting smoke of incipient fires helps save lives.

Avoidance of explosion risks

Dusts create another risk: that of dust explosions caused by spontaneous combustion. Critical processes and production installations such as dust silos have to be monitored continuously to prevent accidents.

TECHNOLOGY



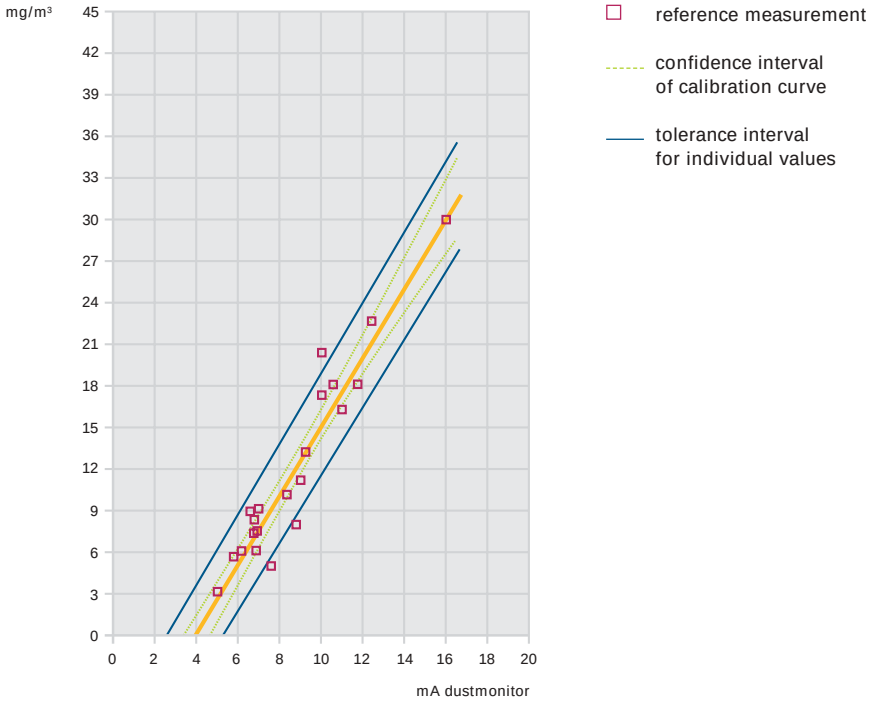
Scattered light measurement

All SIGRIST dust detectors measure dust concentration by detecting the intensity of scattered light. Scattered light is created whenever a light beam strikes dust particles. This effect can be seen whenever the sun's rays come through a window and strike dust particles in the air. The intensity of the scattered light measured at a specific angle is proportional to the concentration of the dust particles.

Calibration

Specifications usually call for the measured dust concentration to be stated in mg/m³ or mg/dsm³. But the intensity of the light scattered by a given dust particle depends largely on the particle's characteristics, such as size, shape, color, etc. Consequently, absolute measurement of the dust concentration can be achieved only by carrying out a calibration for the application in question. This is done by comparing the instrument's reading with a manual gravimetric measurement. Then the reading can be stated directly in mg/dsm³ of the respective substance.

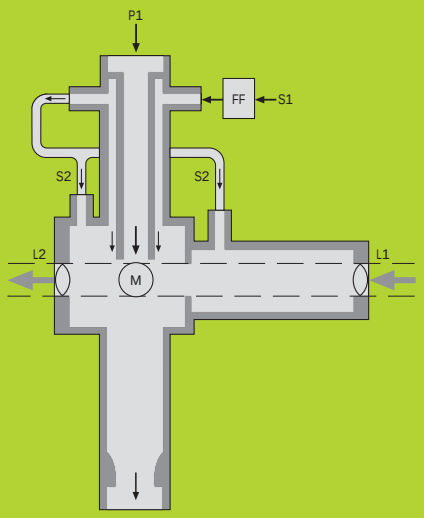
At the factory, SIGRIST dust detectors are calibrated on the basis of a specific dust, namely polystyrene-latex aerosol (PLA) with a particle size of 1 µm. This calibration can easily be checked or corrected by using glasses of known turbidity.



Extractive Measurement

All SIGRIST dust detectors work extractively, which means the sample is transported to the instrument with the aid of a blower. This provides a number of benefits:

- the instrument can be set up at an easily accessible location (with external blower)
- simple zero check with zero-air filter
- possible to heat and/or condition the air
- connections permit measurement of other parameters



Flow cell fouling

Any optical dust measurement system must deal with the problem of dust particles building up on the optical windows and flow cell walls, thereby falsifying the readings. SIGRIST dust detectors eliminate such fouling in a very effective way: a shroud of filtered purge air prevents dust particles from reaching the flow cell walls. The purge air is also passed directly in front of the cell windows, giving them full protection against fouling.

Detection of dust in wet gases

Where wet gases are involved, it must be borne in mind that droplets of liquid (mist) also create scattered light. This renders direct detection impossible, because the instrument's reading would be falsified by the droplets. This effect can be eliminated by heating the sample above the dew point and thus evaporating the droplets of liquid. Because all SIGRIST dust detectors offer the possibility of sample heating, they can also be used measure the dust concentration of wet gases. In the case of air saturated with water vapor, it is normally sufficient to heat the air to 100 °C. Flue gases from combustion process normally contain other compounds such as acids, which increase the dew point and make it necessary to increase the temperature to levels around 160 °C or higher.

STACK EMISSION MEASUREMENT

Detection of particulate matter emissions

All combustion processes produce dust particles. Although these particles consist mainly of carbon (soot), they can also contain or serve as carriers for other substances that are injurious to health, such as metals, hydrocarbons, dioxins, etc. It is desirable to minimize dust emissions in the interest of reducing environmental pollution. For this reason, many industrialized countries set limits on the levels of particulate matter emitted by combustion processes in power plants, refuse incinerators and vehicle engines. Examples are Germany's 13. and 17. BImSchV regulations for power plants and incinerators, European directives 2000/76/EG, 2001/80/EG and the HWC MACT Rule for hazardous waste incinerators in the USA. Beside setting limits, these regulations also prescribe continuous detection. Today's limits lie between 10 mg/dsm^3 and 34 mg/dsm^3. Modern stack gas cleaning systems make it possible to keep emission levels down to 10 µg/dsm^3 or even less, however. So the instrumentation used must be capable of producing a living signal for these low emission levels as well as correctly registering any clearly out-of-limits emissions. SIGRIST dust detectors have a measuring span from a few µg/dsm^3 to several hundred mg/dsm^3 and possess an automatic range switching feature that enables them to react variably to the momentary emission level. Besides the recording of emission levels prescribed by the authorities, the continuous measurement system can also be used to optimize the combustion process within the emission limits.

Instrumentation requirements

In connection with the guidelines on continuous monitoring of particulate matter emissions, some countries also specify requirements to be met by the instrumentation system. In Germany, particulate matter measuring systems must pass a TÜV suitability test to make sure these requirements are met. SIGRIST dust detectors have been certified in Germany under this suitability test in accordance with the EN14181 regulation, and they also meet the requirements established by other countries, such as MCERTS in the UK and PS11 in the USA.

TÜV Rheinland

In situ or extractive

The question of whether detection can take place in situ (right in the stack) or must be done extractively, i.e. using sampletaking, depends on the moisture content of the exhaust gas. Only hot, dry stacks with no risk of water droplet formation as a result of condensation are suitable for in situ detection. But in the case of gases that have been cooled by wet scrubbers and are saturated with water or installations operated close to the dew point of the exhaust gases, the gas has to be extracted and heated above the dew point because of the danger of reading falsification by the droplets produced. SIGRIST is specialized in the extractive detection of wet gases and is the worldwide market leader in this area with over 350 installations.

Extractive detection offers the important bonus of permitting the connection of more sensors to the sample pipe for checking other parameters such as O_2, CO, NO_x, or SO_x.

Dust emission measuring system StackGuard

StackGuard is used for measuring the particulate matter concentration in hot, wet gases. A sample flow of 60 m^3/h is withdrawn from the duct or stack, heated up to 160 °C, and fed to the photometer in a ring pipe. This is where the actual scattered light measurement takes place. The SIGAR control unit handles display and further transmission of the reading, and it also controls the peripheral heaters and blower required for withdrawal and conditioning of the sample. The sampling probe, sample conditioning and equipment configuration are adapted individually to the particular combustion system and flue gas conditions. This makes it possible to arrive at the ideal solution for each application. The maintenance rate will be every 3 month.

PROCESS MONITORING

Dust removal

In many production processes, dust is created by the handling of bulk solids, machining, etc. Examples are the production of detergents, powdered milk, metals, and vitamin C and the processing of tobacco and timber. The dust-loaded exhaust air is filtered with bag filters, cyclones or other separation devices to minimize both product losses and environmental pollution. The exhaust air is normally cold and dry, and after filtration it usually contains very little dust. The air is monitored following the filter or the individual modules in order to detect filter malfunctions or indicate when the time comes to clean or replace individual filter modules.

Safety in the workplace

Dust can also be dangerous in production processes. For one thing, in certain concentrations some dusts are injurious to health, i.e. toxic or carcinogenic. On the other hand, some production processes – such as in medical engineering – set limits on the dust concentration in the interest of product purity. Dust can also cause explosions as a result of spontaneous combustion. Any or all of these reasons can make monitoring of the dust concentration in production rooms or installations advisable or even mandatory.

Monitoring loading bays

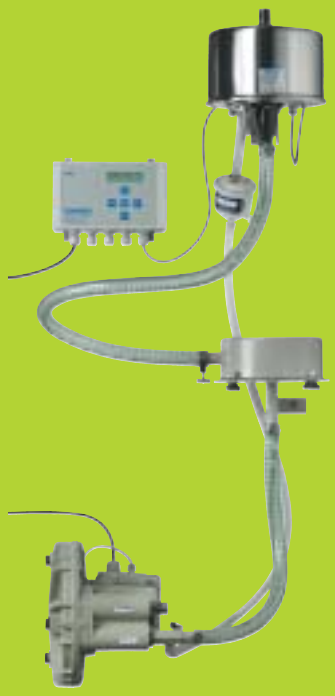
Warehouses and loading bays where trucks and diesel forklifts are used have to be monitored for particulate emission concentrations to ensure work safety. This can be done by measuring the dust concentration. These measurements also serve to optimize energy costs and regulate ventilation.

Dust monitor VisGuard

Dust concentrations of less than 1 µg/m³ PLA and up to 100 mg/m³ PLA can be measured with the VisGuard. The VisGuard In-situ measures the ambient air at the place of installation. With the VisGuard Extractive, an air flow of approx. 25 l/min. is sucked in from the measurement location and fed to the photometer. The suction length can be up to 500 meters.

Multiple sampling

The use of a blower for sampletaking makes it possible to place the instrument several hundred meters away from the measurement point. Furthermore, samples can be withdrawn at a number of different points and fed to an instrument. The individual measuring points can be checked in parallel or one after the other with the aid of a valve unit. This permits economic solutions, especially for monitoring larger installations.



OIL MIST
DETECTION ON TANKERS

Early detection of danger

Because of their combustible and potentially polluting cargo, oil tankers require special safety precautions. This is doubly true for the unmanned engine room as a possible source of hazards. Leaks in the high-pressure fuel lines of the big diesel engines can produce an extremely fine diesel mist that is highly explosive. For this reason, the engine room is monitored continuously for the presence of diesel mist. Because even the tiniest amounts of this mist are indicative of a leak, they have to be detected and signaled reliably. Another potential source of danger is crankshaft overheating as a result of poor lubrication; this can result in a crankshaft explosion. Such overheating is indicated by smoke from burning lube oil. Hydraulic systems can be monitored by oil-mist-detection too.

Monitoring with the VisGuard OMD

A sample collection system draws air continuously from 20 to 40 crucial locations in the engine room and feeds it to the detector. The withdrawal points are divided into 3 or 4 groups by means of a valve unit. Even a tiny leak will cause the reading to rise significantly right away. If it rises above the preset limit, the alarm is tripped. To ensure rapid response and prevent deposits, the air is passed through all lines continuously at high speed.

VISIBILITY MONITORING

Impairment of visibility in road tunnels

The air in road tunnels is routinely contaminated by the soot particles, carbon dioxide and nitrous oxide spewed out by internal combustion engines. Tunnel ventilation systems are therefore monitored and automatically controlled by detecting the visibility as a measure of soot particles or dust concentration, or by detecting the CO or NO concentration. Besides keeping the ventilators operating economically, this ensures that concentrations injurious to health or seriously impairing visibility will not be exceeded. SIGRIST detectors measure the dust concentration by way of scattered light and indicate the result in the form of an extinction coefficient.

Early fire warning

In addition to early fire warning using smoke detection, visibility measurement instruments have been in use in road and railway tunnels since 2002. Tests and current results demonstrate that the measured values during a fire increase significantly above the normal visibility values. Because even cold smoke is detected and alarmed early, tunnel safety is improved considerably.

Visibility detector VisGuard

Its compact construction and sample transmission with a blower permit installation either right inside the tunnel or in adjacent service rooms. The falsifying effect of fog is eliminated by heating the sample. The dual-beam photometer design and the use of purge air keep drift to an absolute minimum, thus permitting long servicing intervals. VisGuard is offered with the multiple control unit SIBUS, to which as many as eight detectors can be connected using a digital bus.

Fire detector FireGuard

FireGuard was specially developed for smoke detection in tunnels. Easy installation and fire detection with adapted sensitivity enables cost-effective deployment. The tried and proven scattered light measurement, an optimized measuring cell, and optional sample heating guarantee both a minimum of errors and low maintenance.

THE INSTRUMENTS AT A GLANCE

Detector	Application	Measurement span
VisGuard	Dust concentration	0 .. 100 mg/m ^{3} PLA
	Visibility	0 .. 15•10 $^{-3}$ E/m
StackGuard	Dust emissions in stacks	0 .. 100 mg/m ^{3} PLA
VisGuard OMD	Oil mist detection	0 .. 100 mg/m ^{3} PLA
FireGuard	Fire-/Smoke detection	0 .. 3 E/m

Photos: stone, photonika www.club-of-communication.com

Represented by:

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