

PARTICLE SIZING - LATEST TECHNOLOGY

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EC The control of particle size distribution is crucial in cement production. We present some of the latest technology from Sympatec.

EC Die Kontrolle der Verteilung nach Partikelgröße ist bei der Zementherstellung von größter Wichtigkeit. Wir stellen einige Beispiele neuester Sympatec-Technologie vor

EC Le contrôle de la distribution granulométrique des particules est un point crucial dans la production de ciment. Nous vous présentons certaines des toutes dernières technologies de Sympatec.

The improvement and guarantee of product quality at the highest level has become one of the important issues for industrial production in general and on a global scale.

In the production of cement, the particle size distribution of the final products is one of the most important parameters for quality, as it guarantees, amongst other things, the final strength of the concrete. However, the particle size distribution is not only important for product quality. It can also be used to characterise the efficiency of the production devices, such as the cement mills and classifiers. Optimisation of operation can not only help to improve product quality, it also has an important impact on the economical aspect of cement production. If, due to immediate control of the milling and classifying circuits the amount of the recirculated coarse fraction can be decreased by only few percent, the yield increases and the cost for energy per ton of cement decreases remarkably. After almost 30 years of rapid development, the laser diffraction method has not only gained a leading position in the laboratory but has also reached the potential to face new challenges directly in the process. Whilst off-line application is suitable for laboratories with different products, or in automated labs, 'at-line' systems handle samples taken automatically without the need of a trained operator. In-line application in addition integrates representative sampling and supplies the particle size information immediately.

Helos laser diffraction system

The principle is easy to explain. Dispersed primary parti-

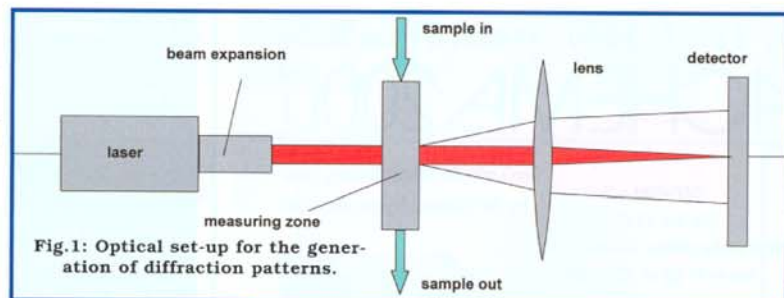
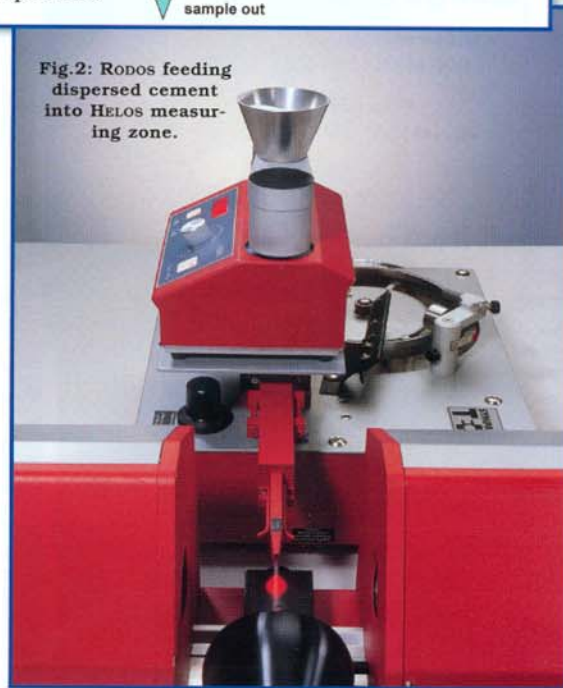


Fig.2: Rodos feeding dispersed cement into HELOS measuring zone.



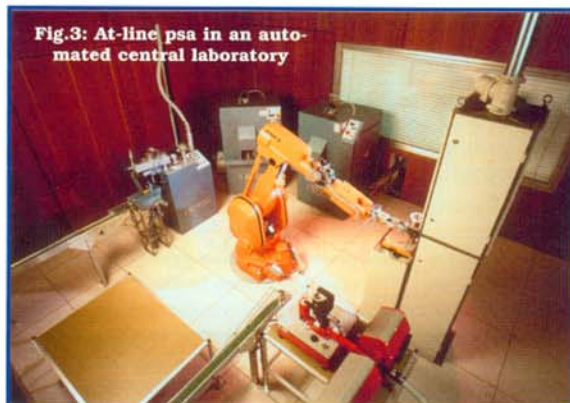


Fig.3: At-line psa in an automated central laboratory

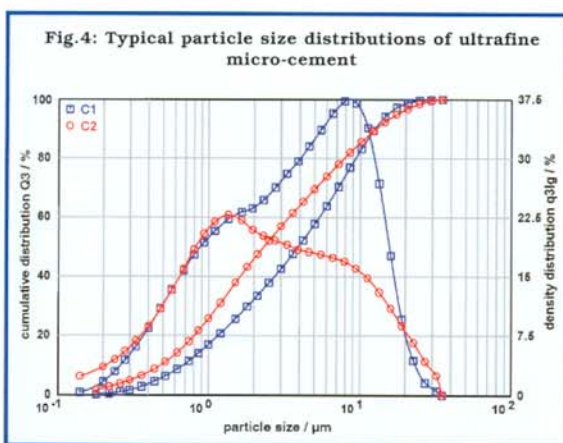


Fig.4: Typical particle size distributions of ultrafine micro-cement

cles pass the parallel laser beams of the sensor (figure 1). The diffraction pattern is collected on a highly sensitive semi-circular multi-element detector. With this input information, the particle size distribution of the sample is determined using the Fraunhofer or Mie theory. As Mie theory cannot cope with mixtures of different components and in addition requires spherical particles with smooth surfaces and a knowledge of their optical parameters, in practical applications only Fraunhofer theory is used.

Different dispersing modules can be applied to optimise the dispersion of dry or wet samples. In general, a dry sample should be dispersed dry and a wet one in suspension because of secondary effects like dissolution or surface reactions.

Instrumentation

The Helos modular laser diffraction sensor was originally developed for laboratory use. Rodos is the dry dispersing instrument for the Helos particle sizing system (figure 2). With a controlled combination of shear forces, particle-particle- and particle-wall-collisions, samples from below 0.1 micron up to the millimetre range are properly dispersed and released into the measuring zone of Helos as aerosol free-jet. The Windox con-

trol and evaluation software is built around a versatile database and offers operation using standard measuring routines (SOP) that can be recalled by pressing a single button and which provides powerful tools for data evaluation, statistics and graphical presentation. A sophisticated module for trend analysis is also available. Typically, a particle size analysis takes less than a minute, including feeding, dispersion, measurement, evaluation and automatic rinsing.

A remarkable number of Helos systems have been installed in the global cement industry. All of them are equipped with a Rodos dry dispersing unit. Many are integrated in automated central laboratories (figure 3). Performance and guaranteed life-time of the Helos & Rodos system is outstanding. The standard deviation over the life cycle of the system is less than 1%, or expressed in terms of the Blaine surface, less than to +/- 40cm²/g for 4000cm²/g. With regard to the long term stability of the dispersing line of the Rodos instrument, Sympatec guarantees a minimum life time of 50,000 measurements of 5g PZ 35 F. Even ultrafine cements are dispersed and analysed reliably with high resolution (figure 4). Reproducibility of less than 1% and system-to-system-comparability of less than 2.5% are guaranteed by Sympatec. Based on this, the product and the process can be optimised reliably. The producer who instantly and exactly adjusts his milling process can guarantee the cement quality which is demanded.

Mytos & Vibri

Mytos & Vibri particle size analysis in the automated lab are a new application for established technology. The

Mytos industrial particle size analysis system is composed of components adapted from the established Helos & Rodos system, thus ensuring complete comparability of results to off-line

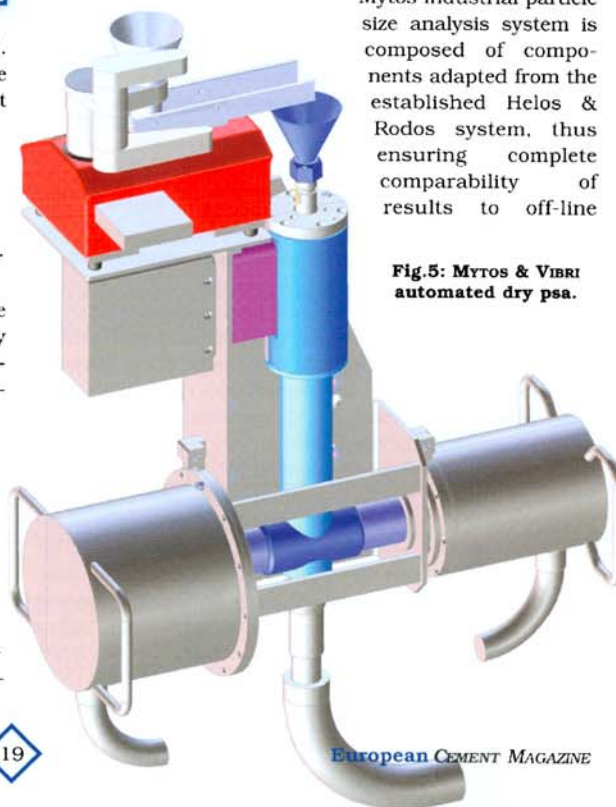
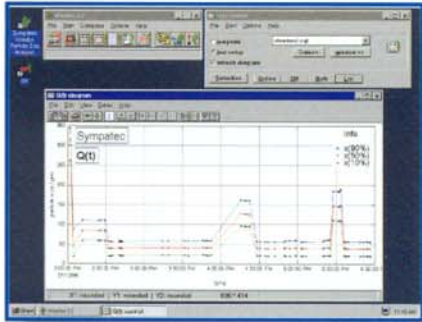
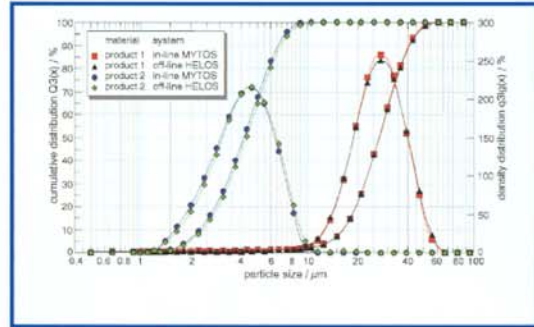


Fig.5: MYTOS & VIBRI automated dry psa.



Left: Fig. 6:
Typical trend graphics of continuous process monitoring

Right: Fig. 7:
Comparison of results with MYTOS & TWISTER and HELOS & RODOS.



analysis. A second injector with sheath flow is used for flow focussing of the aerosol along the centre line. Vibri is a chute feeder with outstanding properties, already established for feeding of Rodos and Gradis.

The constant feeding of the product into the dispersing system is an important condition for complete and homogeneous powder dispersion. Vibri offers a selectable feed rate and integral control of the amplitude, thereby maintaining a constant mass flow independent of load.

Innovative combination

For the first time, this combination opens the field for completely automated operation of particle size analysis in the automated central cement laboratory, including feeding, dispersion, triggering, measurement, evaluation, cleaning and reference measurement. The compact upright design saves valuable room in the lab (figure 5). Continuous particle size analysis generates a lot of data, of which printouts are usually not required. The Sympatec Windox software, which records all measurements in a database, can be set up to show just the key features of the distribution as a trend plot against time, thus allowing effective control of important process parameters without losing any detailed information (figure 6).

Mytos & Twister

Sampling is part of particle analysis. For reliable particle size analysis all steps to the final result are important. In addition to controlled dispersion, sensitive measurement and powerful data evaluation, sampling and sample handling must be representative and reliable. Representative sampling implies that the results of particle size analysis reflect the process flow, hence the particle size information not only refers to the sample but the whole process. Consequently Sympatec has developed a new particle size analysis system with integrated representative sampling.

The Twister is the first link in this innovative chain. Upon a command from the control PC, a sampling finger leaves its shielded parking position at the side of the pipe to start a spiral track into the centre and out again to the side, drawing a sample as it does so. The open end of the sampling tube spends an equal amount of time in all positions in the pipeline. This way the pipeline is sampled uniformly across its cross section. The system copes with a wide range of process conditions, for instance pressures up to 10 bar and temperatures up to 100°C.

Process automation

After measurement with Mytos, the cement sample can be returned into the process or taken out for further use. The results of Mytos & Twister perfectly correspond to those of Helos & Rodos (figure 7). When completely integrated into

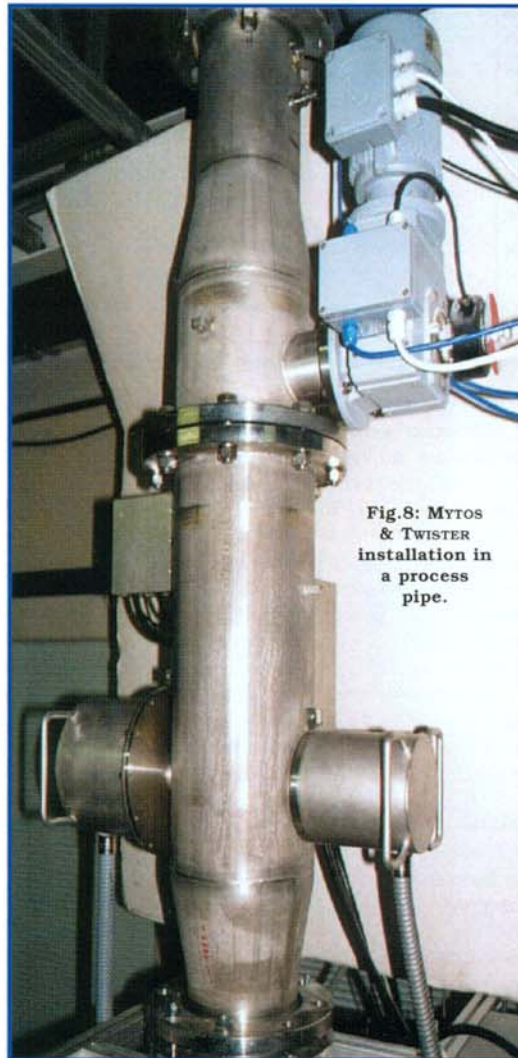


Fig. 8: MYTOS & TWISTER installation in a process pipe.

a process pipeline, the system uses about 1.2m of space (figure 8), but even with only half a metre available, it can be installed with Twister in-line and Mytos on-line outside the process pipeline. If necessary, several Twister units can be connected to one on-line Mytos.

In addition to the advanced data handling, Windox allows the fully automated control of process parameters via programmable logic control. Investment costs for in-line analysers have proven to pay off in the shortest time because of better product quality and money saved through reduced energy consumption.

Summary

As dry products - like cement - tend to react or interact with liquids, Sympatec offers reliable particle size analysis with dry dispersion. The Helos & Rodos system with guaranteed life-time performance, superior reproducibility and system-to-system-comparability are best suited for this challenging task.

Mytos & Twister come as in-line version of this successful particle size analyser with integrated representative sampling. Because of complete comparability and reliability of results, product and process are improved and the investment pays off

in the shortest time.

References

- [1] K. LESCHONSKI, S. RÖTHELE, U. MENZEL: **A Special Feeder for Diffraction Pattern Analysis of Dry Powders. Part. Charact.** 1, 7-13 (1984)
 - [2] U. KESTEN: **Control and Optimisation of Cement Quality with Laser Diffraction Particle Size Analysis and Dry Dispersion. Fifth NCB International Seminar on Cement and Building Materials, New Delhi, (26 - 29 November 1996)**
 - [3] M. PUCKHABER, S. RÖTHELE, W. WITT: **In-line Laser Diffraction - Proven Particle Size Analysis in Industrial Environment. Powder Handling & Processing Vol. 10, No. 4, 416-421 (1998)** EC
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