



DRY PROCESS SAMPLING

QCX/AutoSampling™

REPRESENTATIVE SAMPLING

As a customer, you can always trust that the essential requirement for representative sampling is in focus for any sampling solution delivered by FLSmidth Cement.

Having completed hundreds of industrial process stream sampling projects, FLSmidth Cement is a competent and experienced supplier of complete sampling solutions to the cement industry. We understand the basic theory of sampling (TOS), the rules of good, representative sampling practices as well as applicable industry specific international standards. Combining sampling with deep knowledge of relevant processes and industry specific experience, we have translated the theoretical specifications into practical, efficient and cost effective sampling solutions.

Homogeneity of sample process flows

All material in a process flow must have an equal probability of being sampled.

This is a basic principle in representative sampling, and should therefore always be seen as the ideal sampling concept. The ways in which this ideal sampling concept is translated into practical, cost effective sampling equipment solutions, differ from industry to industry and from one sampled material to another. It also depends greatly on the homogeneity of the sampled process flow.

Proper selection of sampling devices and their location is always of utmost importance to meet the overall objective of sampling, analysis and related process optimisation.

There are no methods of analysis that can compensate for errors/bias in the sampling stages. Therefore, it is crucial to always ask yourself if the sampling method is adequate when investing in sophisticated analysis technology.



This brochure describes our sampling products for the cement industry as well as including our automatic sample transport product program, which complements our samplers to provide a fully automatic sample collection from process to a central laboratory facility and/or to online analysers.

GY'S RELATION BETWEEN PARTICLE SIZE AND MINIMUM SAMPLE MASS

Particle Size:	Sample mass:
20mm	13kg
10mm	4kg
5mm	1kg
3mm	400g
1mm	100g
0.5mm	25g

Derived from the work of the 'father' of the Theory of Sampling (TOS), Pierre Gy, these figures show the theoretical correct minimum sample mass in one cut of a solids material stream as a function of the largest particle in the sampled material.

MATERIAL MASS FLOW FROM PROCESS TO ANALYSIS

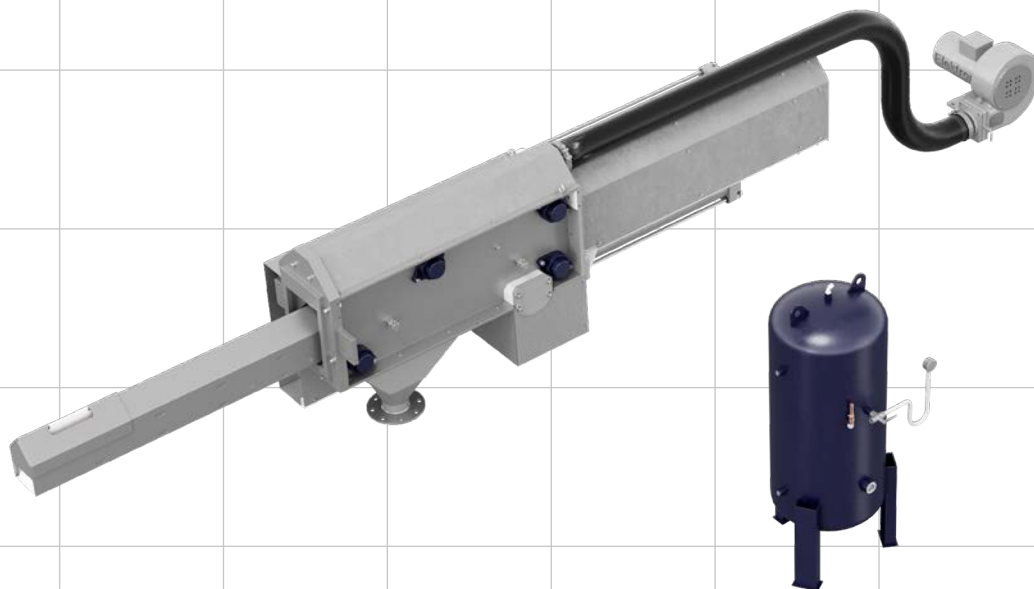
Grinding mill	200 t/h
Sampled composite mass (primary sampling)	20 kg/h
Sample mass to lab (secondary sample split)	200g
Prepared sample mass (tertiary sample split)	20g
Analysed sample mass	<<0,1g

The table illustrates the masses involved in sampling and X-ray analysis of a typical dry powder process stream, and demonstrates the importance of homogeneity and sample representation.



HOT CLINKER SAMPLER QCX® PSK101/112

The PSK Hot Clinker Sampler takes samples of hot materials such as cement clinker falling from a rotary kiln. It can also be used for nickel reduction kilns or other pyro-processes. Complete with in-built damage protection, this is a robust machine that offers exceptional safety and requires low maintenance.



An external ventilator cools the sample directly on the spoon. This allows for more frequent sampling intervals, which helps control heat and reduce fuel consumption. It also minimises wear on kiln bearings and linings.

The sampler is especially beneficial when combined with an at-line analyser or an automatic sample transport system. This speeds up access to information so your operators can optimise their kiln process. Overall, the Hot Clinker Sampler provides a safe and reliable solution for representative material sampling, aiding efficient production quality control.

KEY BENEFITS

Low maintenance: damage prevention features allow the sampler to automatically withdraw from the process environment if there is a loss of power or compressed air. This ensures the sampler is not damaged by prolonged exposure to the hot process.

Fast processing: with a sampling frequency of up to one sample every 15 minutes at 1,450°C, the Hot Clinker Sampler gives you fast feedback loops. Frequency can be increased at 900°C or lower to one sample every four minutes.

Automatic systems: the Hot Clinker Sampler seamlessly integrates with your GCX system and other automatic sampling systems. Automation helps protect your operators from the hot, dangerous environment. It also gives you a future-proof solution ready for fast extensions and upgrades.

SAMPLING IN THE CEMENT INDUSTRY

Backed by over 125 years as a supplier of process machinery, FLSmidth Cement has a comprehensive cement plant sampling product program covering basically every occurring process activity from boreholes, exploration/quarry blasts to delivery/dispatch of cement.

Use of pre-engineered off-the-shelf standard solutions means:

- Short delivery time
- Cost effective solutions
- Consistently high sampling quality
- Reliable equipment operation
- A safe choice

Sampling takes place throughout the cement plant for checking chemical processes, process optimisation and checking silo homogenisation as well as for documentation of product quality at various product stages. Typical analyses (but not all) conducted on the sampled material comprise:

- Elemental analysis (by XRF)
- Mineral composition (by XRD)
- Humidity
- Fineness, e.g. particle size distribution, Blaine, sieve residue etc.

Two types of sampling programs exist:

A) A routine sampling program is conducted at frequent intervals (every ½, 1, 2, 4, 8 hours or longer intervals) during normal operation. These samplers are permanently installed at designated locations and usually operate fully or semi-automatically. Most samplers collect composite samples in the time intervals between sample collection, but spot sampling is regularly used at a few locations. Samples are collected on a defined time schedule and brought to the laboratory manually or automatically; in the latter case by means of automatic tube transport systems.

B) For initial commissioning of process equipment and for trouble shooting purposes, the samplers mentioned under A) will naturally be used, but they may not be sufficient to provide all the necessary details. Therefore, it is required to have a number of inspection sampling access points, where manual spot sampling devices can be inserted to extract random samples.

Using FLSmidth Cement terminology we distinguish between:

Inspection samplers

Manually operated, which are simple, movable mechanical devices for spot sampling and performing activities listed under B) above.

Automatic samplers with manual sample collection

Permanently installed, which are automatically operating samplers for routine sampling with manual sample collection.

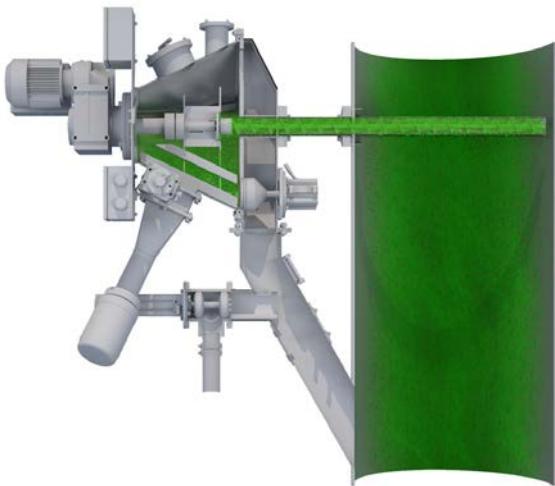
Automatic Samplers

Permanently installed, which are automatically operating samplers for routine sampling with automatic sample collection via tube transport system.

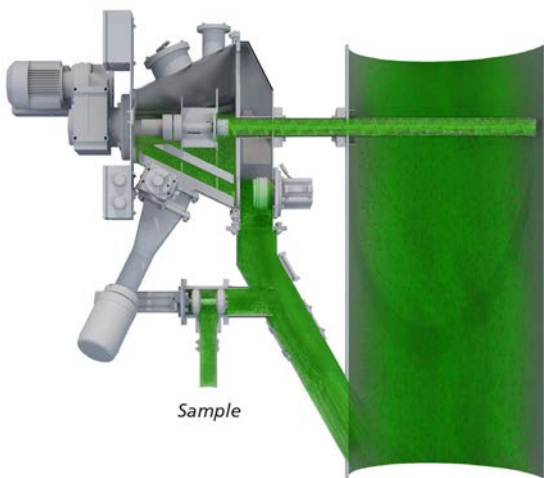
The following pages outline the off-the-shelf cement industry sampling solutions – manual or automatic - we apply in FLSmidth Cement for new cement plant projects as well as for projects with delivery of sampling equipment to existing plants. In our experience, well over 90% of all sampling requirements can be solved by selecting one of the preengineered standard solutions. In the remaining few cases, a customised project solution may be built from a wide range of standard components available.

Many of the listed sampling solutions are built around two key sampling components: the PSM chute sampler and the PSA air slide sampler. Let us take a closer look at these in terms of how the composite sampling is arranged and how the sample delivery/collection takes place manually or automatically.

CHUTE SAMPLER



A sampling screw (auger) rotates slowly (a few rpm's) and continuously extracts powder material from the sample process stream in a vertical or close to vertical chute section. A mixing tank – on the same axis as the screw – collects the material for a composite sample. The mixing tank has internal lifters rotating with the auger, which means that the sample material in the tank at all times is a homogeneous mix. The variable frequency motor can be adjusted, so that the time it takes to fill the mixing tank is within 1/2 to 2 hour, with 1/2, 1 or 2 hours as the typical sampling intervals.



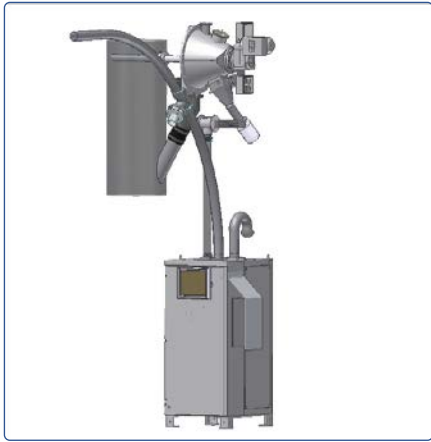
AIR SLIDE SAMPLER



A sampling tube with a thin slot is placed with the slot located opposite the direction of the material flow. With intervals of a few minutes, the tube is rotated 180 degrees, so that the slot is focused on the material flow and a small sample portion (=sample increment) is collected and routed to the mixing tank. The mixing tank has internal lifters rotating with the mixer motor, which means that the sample material in the tank is always a homogeneous mix. The amount of filling required to equal a 1/2, 1 or 2 hour sampling frequency is controlled by the time interval of rotating the sampling tube.



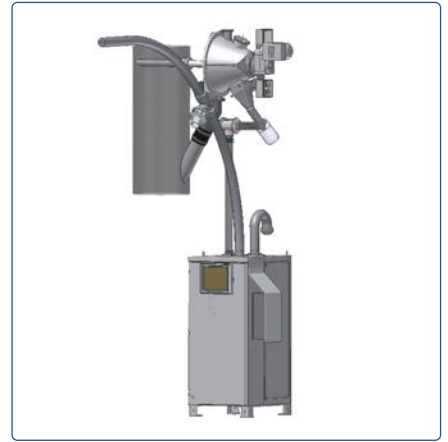
SAMPLING IN THE CEMENT INDUSTRY



1. raw meal



2. Filter dust



3. Kiln feed




4. Hot meal




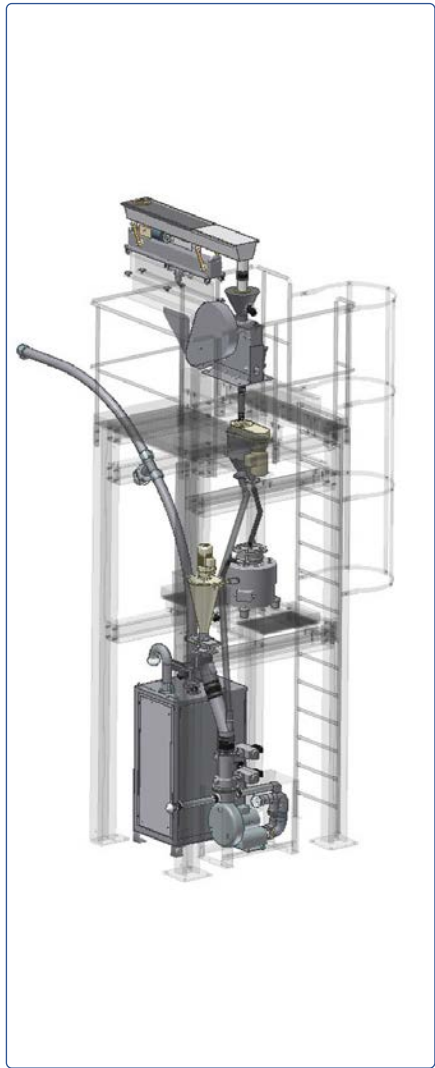
5. Coal meal



 Manual sample collection.

 Automatic sample collection via tube transport system.

 Alternative sampling location.



6. Clinker



7. Cement mills



8. Cement silos & cement dispatch

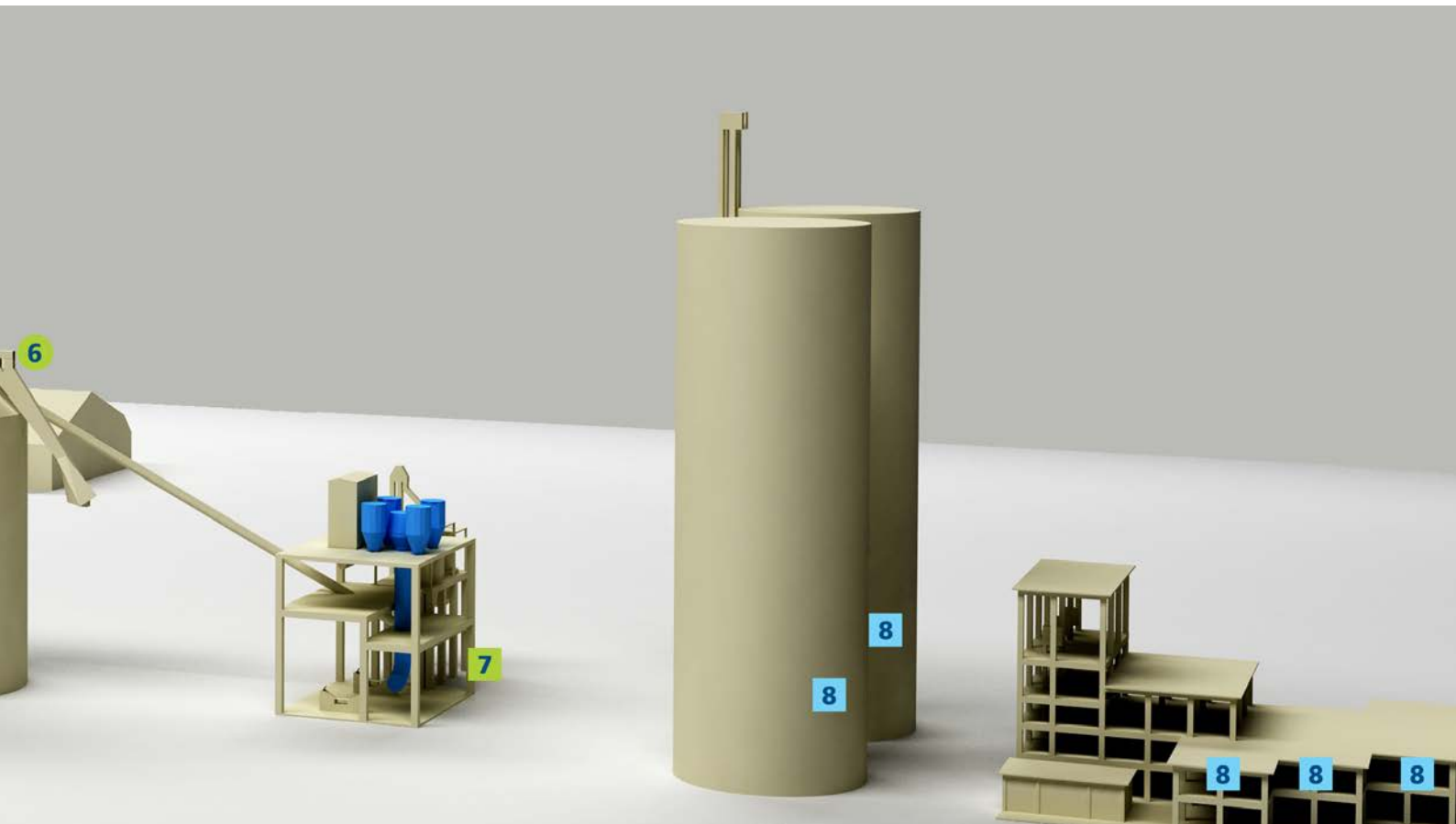
A high degree of automation in sampling means that all samples are taken:

- at the right time
- at the right place
- consistently

Further important benefits of automated sampling from an experienced professional supplier such as FLSmidth Cement include:

- representative sampling
- minimum sample to sample cross contamination
- fail-safe sample identification
- correct time stamp
- automatic product assignment

The below diagram outlines a typical selection of samplers employed for a modern cement plant from FLSmidth Cement: 5-7 sampling locations have automatic transport integrated with the automatic samplers. Another 4-8 sampling locations are equipped with samplers with manual sample collection. Manually collected samples may enter the automatic transport system via manually operated sending stations, servicing a number of nearby manual sampling locations.



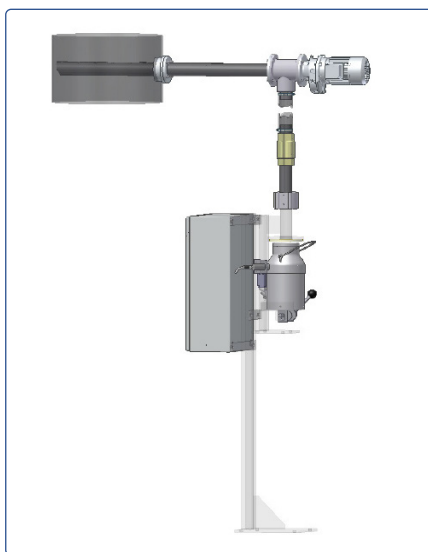
SAMPLERS WITH MANUAL SAMPLE COLLECTION

This page outlines the greater part of available off-the-shelf solutions for manual samplers, which in our terminology means automatically operating sampling devices, where activation of the sample delivery and sample collection is manual.



A local control box is an available option for all samplers with manual sample collection.

If not included within FLSmidth Cement's supply range, the customer must supply the sampler control either from the central control system or a local control box.



Screw spot sampler (shown with optional local control cabinet)



Airslide spot sampler (shown with optional local control cabinet)

TYPICAL KEY SPECIFICATIONS FOR MOST POWDER SAMPLERS

Ambient temperature range	-10 ~ +40 [°C]
Extended temperature range w/extra components	-20 ~ +55 [°C]
Maximum temperature of sampled material	120 [°C]
Maximum particle size of sampled material	2 mm
Compressed air supply	Dry, oil free, -10 bar
Electrical power supply	3 phase; 360-480 V
Protection class	IP 34 (dust IP54)

Required pneumatic control components are always included in the scope of supply and are delivered in separate pneumatic control box.



Screw spot sampler in ATEX execution for sampling of coal meal.



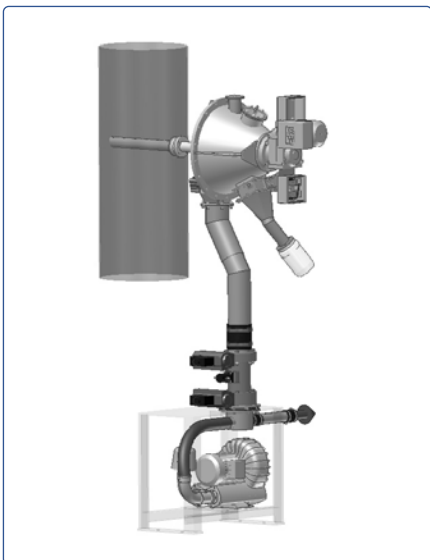
Hot meal spot sampler including water cooling device for fast cooling of sample.



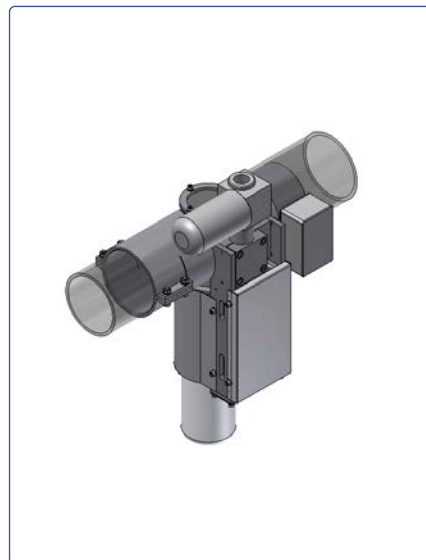
PSM composite sampler in standard version with gravity return of excess sample material.



Airslide composite sampler with excess sample material return blower.

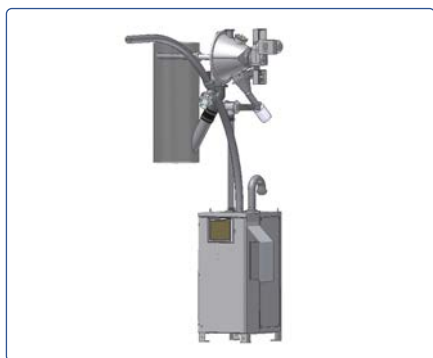


PSM composite sampler in optional version with excess sample material return blower.

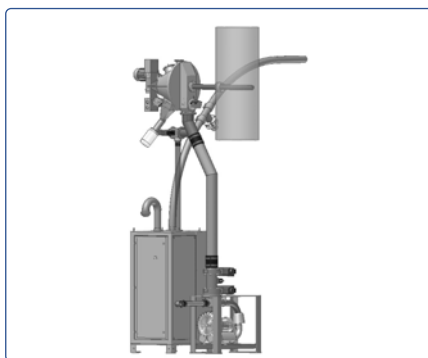


Sampling device for borehole dust delivering an aggregate sample, with sample material layered in accordance with borehole depth.

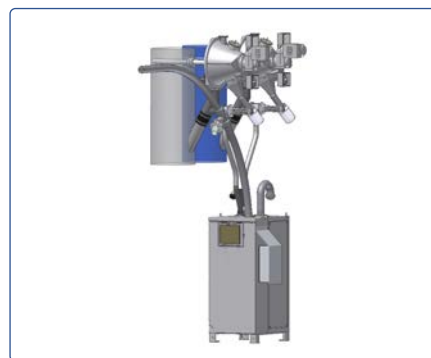
AUTOMATIC SAMPLING SOLUTIONS



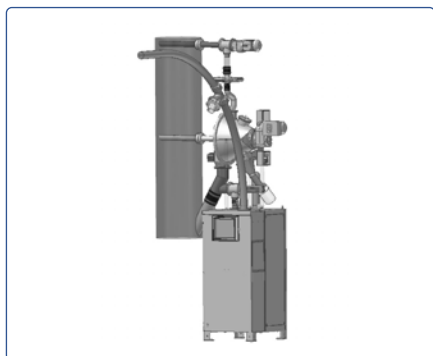
PSM composite sampling station with gravity return of excess sample material.



PSM composite sampling station with excess sample material return blower.



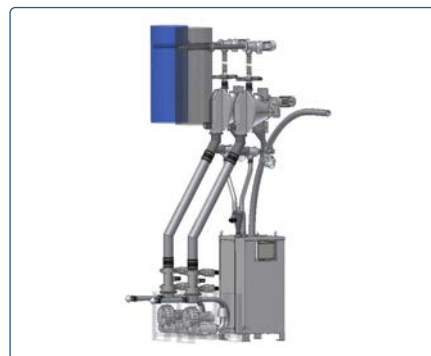
Dual PSM composite sampling station with gravity return of excess sample material (Two sampling points served by one shared sample transport sending station).



PSM composite & screw spot sampling station with gravity return of excess sample material.



Screw+mixer composite sampling station with excess sample material return blower.



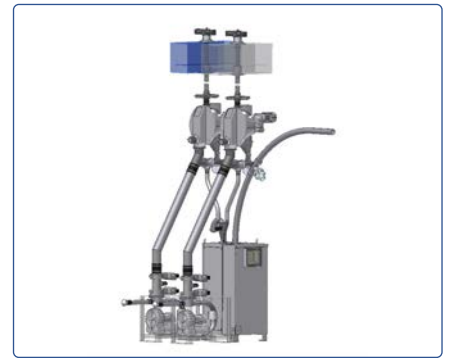
Dual screw+mixer composite sampling station with excess sample material return blower (Two sampling points served by one shared sample transport sending station).



Screw+mixer composite & screw spot sampling station with gravity return of excess sample material.



Airslide+mixer composite sampling station with excess sample material return blower.



Dual air slide+mixer composite sampling station with excess sample material return blower (Two sampling points served by one shared sample transport sending station).



Air slide sampler+mixer composite & air slide spot sampling station with excess sample material return blower.



Hot meal spot sampling station including water cooling device for fast cooling of sample.

AUTOMATIC SAMPLE TRANSPORT

Automatic sample transport complements automatic sampling and creates fully automated sampling procedures:

- Fast turnaround time from sampling to analysis
- Improved product quality and related operational savings
- Optimised overall sample taking schedule
- High system availability
- Easy connectivity to automatic sample preparation systems
- Worldwide service & support

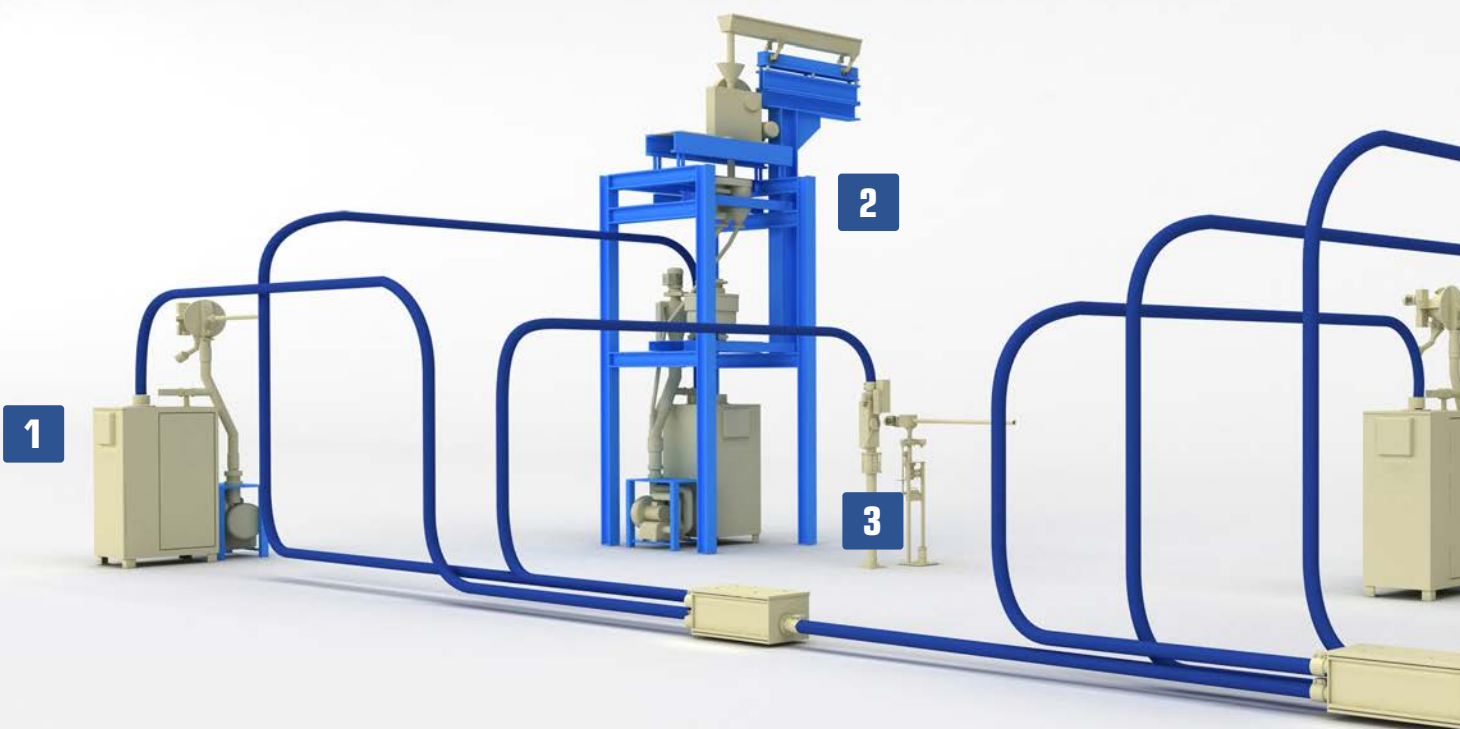
Tube transport systems have been employed for fast sample transportation in harsh industrial environments since the 1960s. FLSmidth Cement has been involved since the early days and has gained a market leading position within this technology through execution of hundreds of projects with automated sampling and sample transportation to customers worldwide.

QCX/AutoSampling provides automatic sampling and pneumatic transport of sampled material from the process areas to a central production laboratory or to designated „satellite“

laboratories. Manual, semi-automatic, or fully automated send/receive stations are available both at the process end and at the laboratory end of a pneumatic sample transport system. Sampling equipment for powder, granulate or and lumpy materials can be connected to the process send/receive stations, thereby ensuring fully automated procedures.

A typical project scope may comprise:

- Automatic sampling equipment
- Process send/receive stations
- Transport tube & lube diverters
- Transport air blowers
- Project specific control hw & sw
- Optional sample ID entry terminals
- QCX/AutoSampling supervisory software
- Project Engineering services
- Factory Acceptance Testing
- Installation supervision and commissioning services



Samples are transported in sample cartridges (or carriers or shuttles). For dry powder/granulates, typically 200-500 cc material is sent to the laboratory. For steel/metal samples ("lollipops" or similar), a special cartridge with a clamping device is employed.

One or more rotary blowers integrated in the tube network generates an over- or under-pressure, which allows the cartridges to move at transport speeds between 8 and 20 metres per second. Send/receive stations – in the process area or in the laboratory – may be manually serviced or fully automated, which at the process end means full automation of the entire sampling & sample transport process. At the lab end, full automation implies that powder/granulate sample portions are automatically dosed into one or more sample cups for further preparation and analysis, while steel/metal type samples are released from the clamping device and transferred to the relevant piece of preparation equipment.

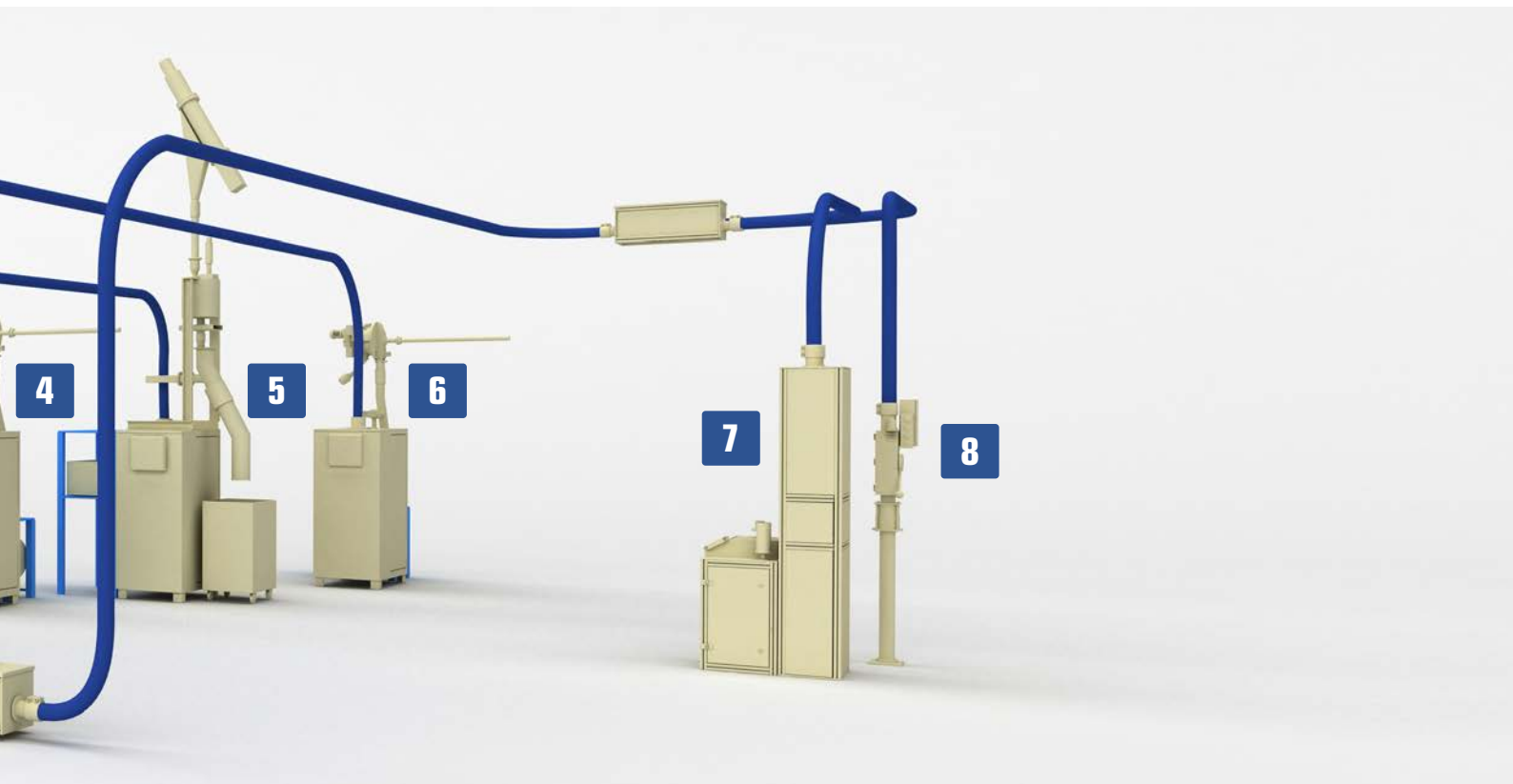
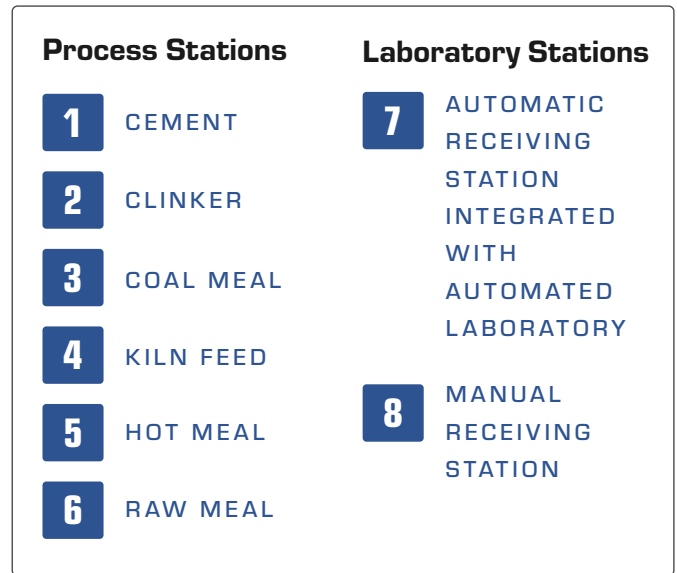
The emptied cartridges are thereafter returned to the process station they arrived from. In the steel and metals industry, the requirements for very rapid sample analysis are met by so-called „point-to-point“ tube connections to allow multiple parallel sample transport. In other industries, e.g. a cement application, one tube transport line with a number of tube diverters often services several sampling points.

The sampling and transport system is controlled from built-in control components undertaking the equipment device control and a central QCX/AutoSampling PC/PLC system, which takes care of the coordinated traffic control, sample identification, sampling schedules, transport priorities, visualisation, alarms etc.

The applied advanced logic control programming techniques („QCXSYS“) ensures cost effective engineering for the specific project as well as providing a very high quality and consistency

in both overall and device control. Directly from the PC screen, mimic diagrams (so-called „face-plates“) provide easy accessible operational and diagnostic details from the device control level.

Samples are sent from the process stations to receive/send stations in the laboratory in accordance with individual sample priorities and wait list status. Sample entities like sampling location, product type, sampling time etc. are automatically passed on to the next handling stage, whether manual or automatic. The integrated automation concept includes advanced priority handling schemes: in case an equipment error leads to reduced capacity in the automated preparation system it is possible to automatically scale down the automatic sampling & sample transport activity, so that lower priority samples are skipped or called for less frequently.



FLSMIDTH CEMENT

www.flsmidth-cement.com

Copyright © 2024 FLSmidth Cement. All Rights Reserved. FLSmidth Cement is a [registered] trademark of FLSmidth Cement A/S, and FLSmidth Cement is authorized to use the trademark under a license agreement. This brochure makes no offers, representations or warranties (express or implied), and information and data contained in this brochure are for general reference only and may change at any time.

