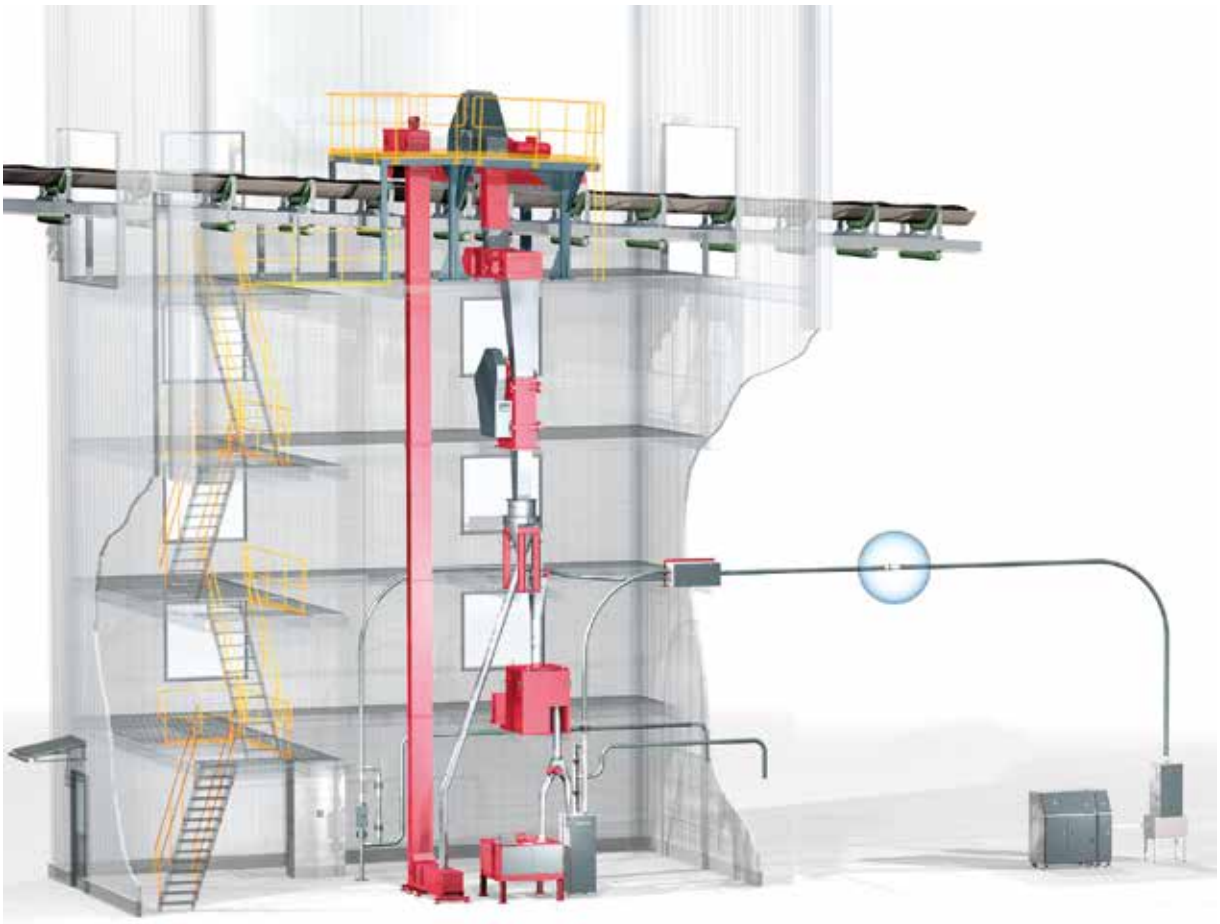
SIEBTECHNIK TEMA



Sampling and sample preparation

Individual units and plants

SAMPLING AND SAMPLE PREPARATION

Without these processes there would be no analytics and this also shows their importance. After all, without representative sampling and representative sample preparation in accordance with the requirements for analysis, one would still expect results, but of what value would these be?

Representative means here that for all particles of a material quantity to be sampled there is the same chance to be found again in the analysis sample.

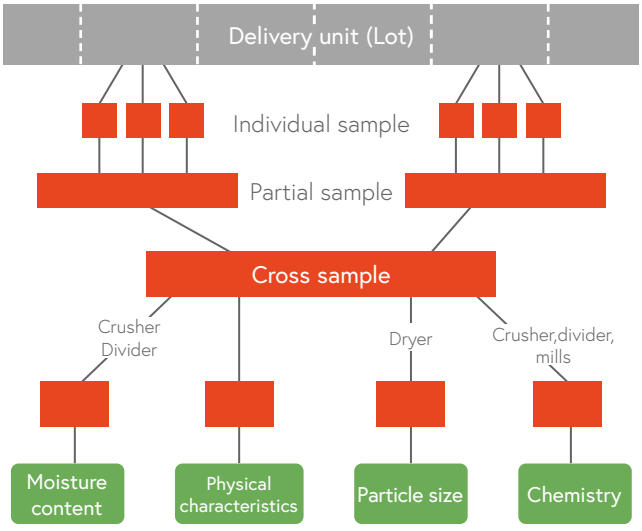
Following this principle, Siebtechnik supplies single units or complete systems for sampling, sample processing and sample analysis of bulk materials and suspensions.

As high values are involved in the trade of large quantities of bulk material, such as ores, fuels or fertilisers, national and international standardisation committees are establishing rules on how sampling, sample processing and analysis are to be carried out.

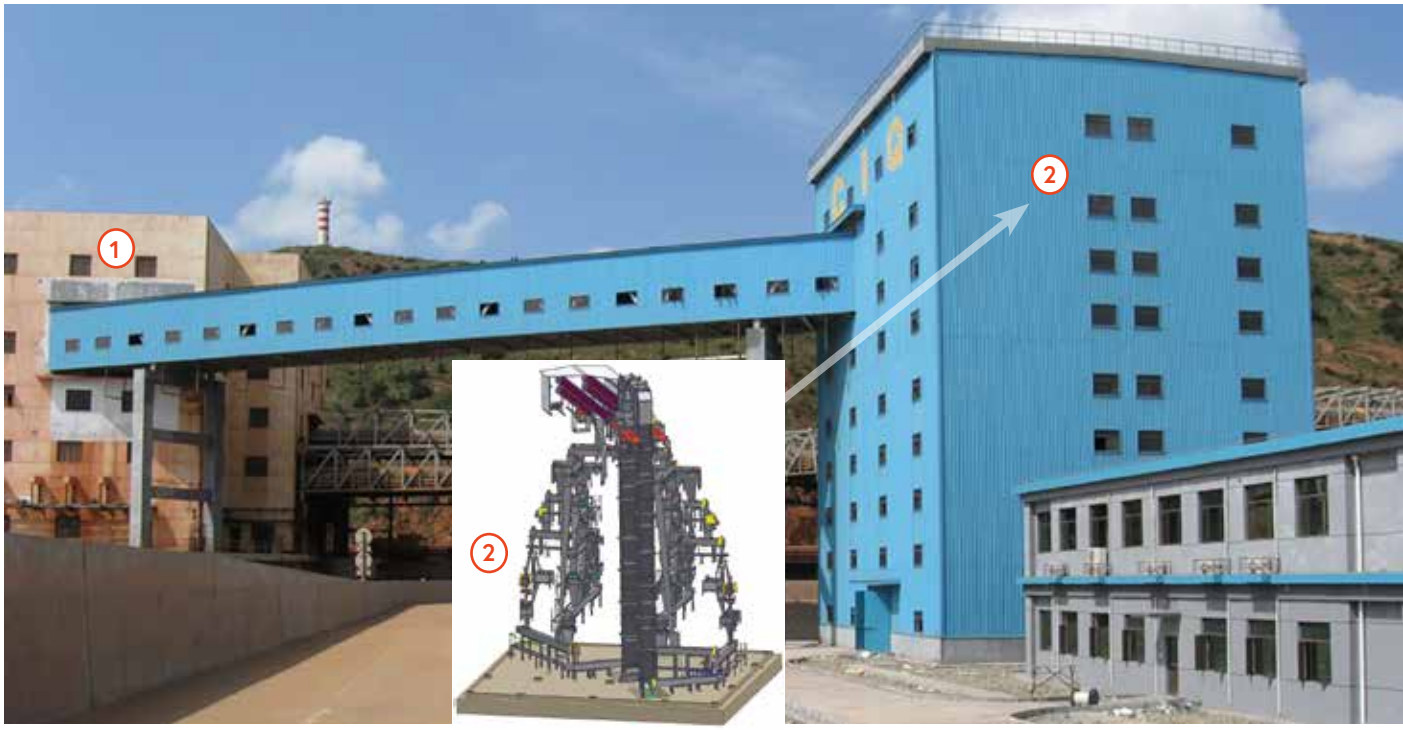
The process design of plants, as well as the design of the machines themselves, therefore always takes into account the relevant standards.

Sampling describes the process of taking samples of partial quantities (= individual samples) from the total quantity to be sampled (= delivery unit).
The sample processing includes all steps from sampling to analysis.
The requirements for sample processing are determined by the subsequent analysis, for example:

- Analytical samples for particle size and strength tests must not be comminuted and must be prepared as gently as possible.
- Analytical samples for an analysis of the chemical components have to be prepared in several stages of comminution and subdivision.
- Analytical samples for moisture analysis must neither be heated nor stored open to minimize any loss of moisture.



Sampling (**1**) and sample processing (**2**) of coal during ship loading



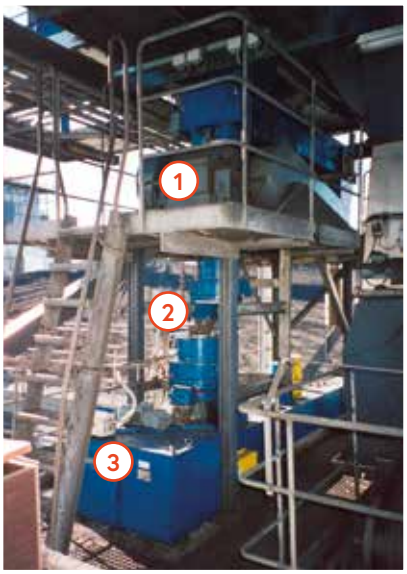
Sampling of iron ore, slot vessel sampler (**1**) and sample processing (**2**)

Fundamentals

The term 'sampling' means all operations necessary to take individual samples from a delivery unit in such a way that they correspond with the expected precision to the total quantity in qualitative terms and without systematic error.
The subsequent 'sample preparation' includes all operations necessary to bring the sample material taken during sampling (individual samples) into the state required for the subsequent examinations.

During sampling, note that bulk goods - especially raw materials and initial products - are frequently very inhomogeneous with regard to the quality characteristics relevant for the evaluation.

Sampling in coal unloading crane



Double-roller mill (**1**)
Turnstile divider (**2**)
Sample collector (**3**)

SAMPLING AND SAMPLE PREPARATION

The more uneven a material is, i.e. has a high flow of material variance at the sampling location, the more frequently sampling must be carried out. This is the only way to obtain a cross sample with sufficient precision. The taking of a large number of individual samples inevitably leads to the processing of large cross samples and can be very costly. The number of individual samples to be taken should therefore be adjusted according to the nature of the material to be sampled and the precision to be expected.

During the subsequent sample preparation, it must be taken into account that the cross sample developed from the individual samples reflects the homogeneity of the material to be sampled. In all operations, it is essential to ensure that the sample is prepared without significant loss of characteristics (e.g. water content).

The high requirements to be made on the technical design of facilities for sampling and sample preparation result, among other things, from the very high ratio of the quantity of material to be examined in relation to the total quantity to be evaluated.

This can be illustrated by the ash content, for example. A sampling quantity of a few grams is sufficient for the analytical determination, but it must have the same ash content as the 200,000 t ship cargo from which this analysis sample was taken.

Ship cargo — 200,000 t

1: 10,000

All individual samples — 20,000 kg

1: 1,000

Cross sample — 20 kg

1: 2,000

Analysis sample — 10 g

TOTAL 1: 20,000,000,000

The requirement that the analysis sample to be examined must correspond to the corresponding delivery quantity with regard to the quality characteristics to be determined can be complied with relatively easily on goods in motion. It is only necessary to ensure that the samples are taken in sufficient quantity and frequency over the entire cross-section of the flow of material and are not overlaid with periodic process technology events.

When the goods are at rest, taking a representative sample is very difficult and almost always only possible with restrictions.

General rules for plant design

As already mentioned, sampling can be carried out most easily on the moving goods - on the belt, in the belt transfer or in the downpipe.

It must always be ensured that each sample represents a cross-sectional sample of the entire flow of material. The flow of material must therefore be recorded in its entire width and strength and further homogenized.

The quantity of material produced during sampling shall be decisive for the dimensions of the sampling vessel and, taking into account the sample frequency, for the design of the downstream equipment for comminuting, dividing and collecting the sample material.

The weight of an individual sample is calculated according to the following numerical value equation:

$$m_{EP} = \frac{\dot{m} \cdot SW}{v \cdot 3600}$$

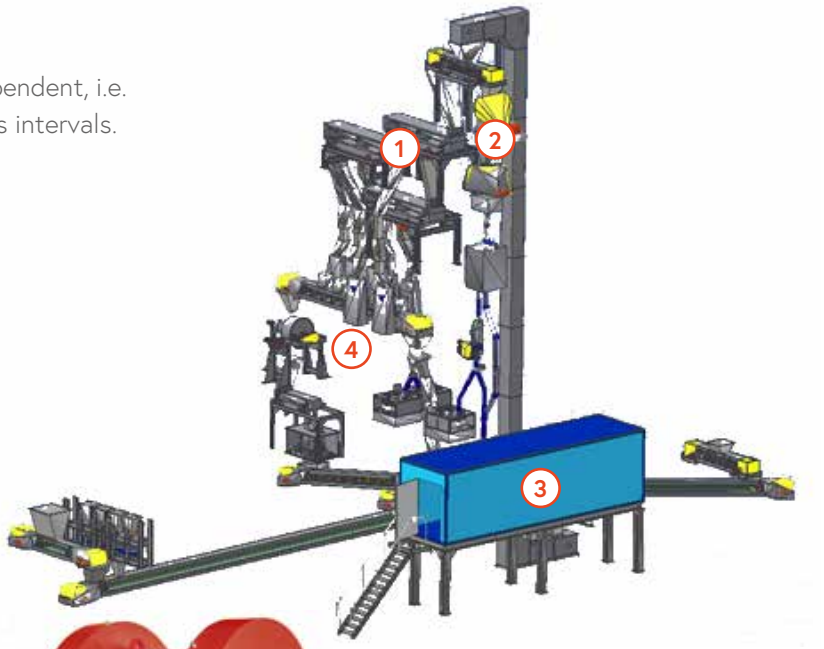
m_{EP}	Weight of the individual sample quantity in kg
$\dot{m}$	Belt load in t/h
SW	Slot width of the sampler in mm
v	Slot vessel sampler: Travelling speed of the slot vessel sampler in m/s Hammer sample taker: Belt velocity in m/s

Sampling for sinter

The taking of this sample is time or mass dependent, i.e. either in equal time intervals or in equal mass intervals.

Screening machine (**1**)

Weighing and dosing units (**4**)



Jaw crusher (**2**)

Autom. milling and pressing system (**3**), Analysis-precise tablet

The slot width of the sampling device should be three times the nominal maximum particle size (nominal top size) of the material. The nominal maximum particle size indicates the particle size at which the residue on the corresponding screen must not exceed 5%. However, a slot width of 30 mm should not be undercut even with finer material.

Sampling of limestone

Sampling system for copper concentrate

The speed of the sampling device must remain constant during the entire sampling procedure. When sampling from the falling flow of material, the passing speed of the sampling vessel should not be higher than 0.6 m/s if possible. Otherwise, a particle size selection by the sampling vessel could occur.

SAMPLING AND SAMPLE PREPARATION

Depending on the particle size and the type of further analyses, the sample material produced must now be crushed in order to be able to divide it further. When selecting the comminution unit, care must be taken at each comminution stage to ensure that machines are used which do not falsify the quality indicators. For example, when determining water content, never work with a fast-running unit. Due to the ventilator effect of this comminution unit, water loss is to be expected with certainty.

When subdividing the samples, the same applies as when sampling the individual samples, i.e. each particle must have the same chance of ending up in the sample. Otherwise, the subdivision step is not representative. Before each further sub-step, a comminution stage should always be provided for upstream, which reduces the particle size of the material and thus further homogenises it.

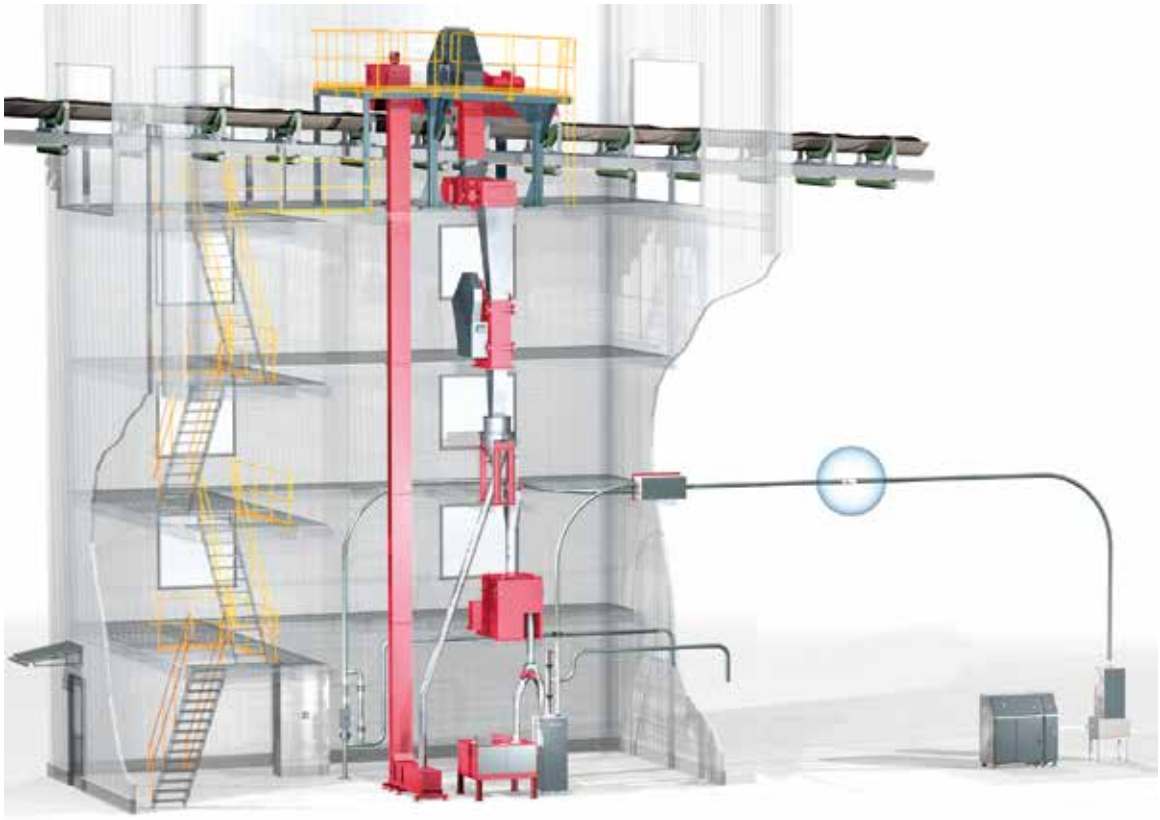
UNITS FOR SAMPLING AND SAMPLE PREPARATION

Sampler

The basic equipment for a sampling system usually consists of the actual sampling device and the machines for sample processing.

Usually, the sampling quantities are comminuted and reduced directly on site to a quantity that is reasonable for the laboratory for further analysis. This then requires at least one crushing stage and a partial aggregate, as well as the sample collector, for storing the sample masses over a longer period.

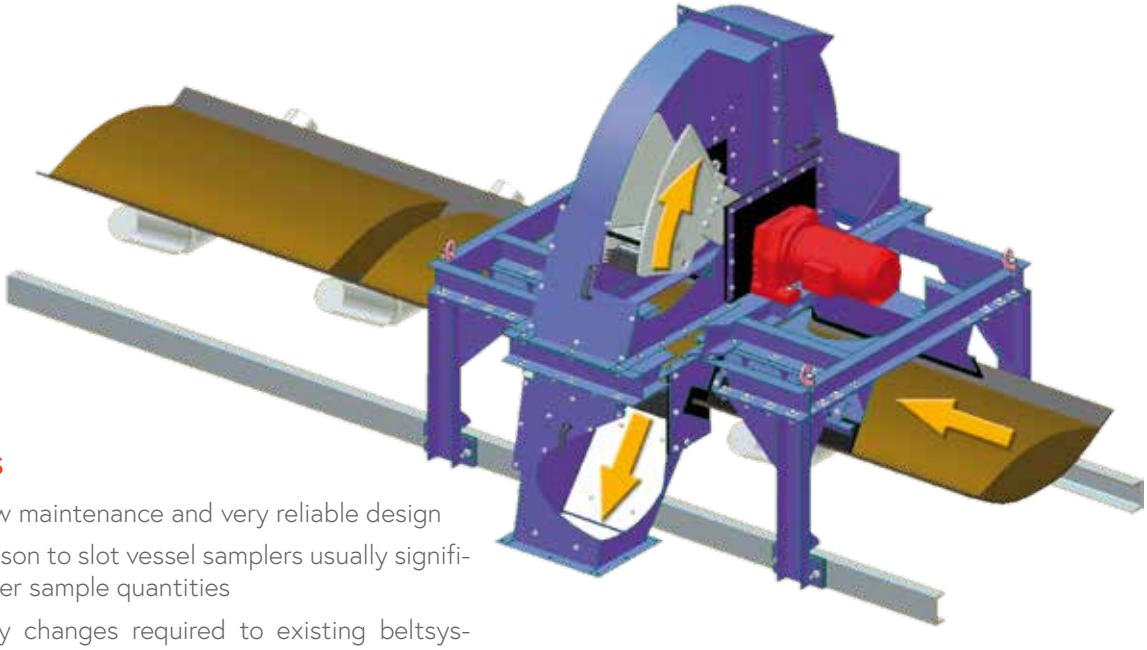
In order to set up a representative sampling system, the quite different products, the local conditions at the place of installation and the widely varying conveying capacities must be taken into account in addition to many normative concerns. This usually requires an individual, custom-made solution based on the units presented below.



Hammer sample taker

The hammer sample taker is used for sampling materials from belt conveyors. The sampling principle of the sampler is similar to that of the sampling frame, which serves as a reference sampling from the stopped belt. The hammer sample taker guides this one-sided closed sampling frame in a circular motion through the moving material flow on the belt. It automatically takes a representative cross-sectional sample from the belt, which corresponds to that of the sampling frame. In order to ensure that the belt is not damaged and to obtain a complete and representative sample, the shape of the sampler must be adapted to the different belt cross-sections and belt troughabilities. This also includes the use of brushes and rubber wipers, which ensure that the fine components adhering to the base of the belt are discharged into the sample and do not remain on the belt

Hammer sample taker		HPN
Belt width	mm	400 - 2,400
Weight	kg	350 - 5,000



Advantages

- Simple, low maintenance and very reliable design
- In comparison to slot vessel samplers usually significantly lower sample quantities
- Hardly any changes required to existing beltsystems for subsequent installation

Slot vessel sampler

The slot vessel sampler is used to sample materials at the belt head or a downpipe.

This sampling principle is based on a slotted vessel with a defined inlet slot vertical to the dropping material flow that covers the entire strength of the flow of material at a constant speed.

The slot vessel sampler passes through the flow of material from the waiting position, with the bottom flap usually open, and closes the same when the reverse position is reached. With the bottom flap closed, the sampler now travels back through the product flow at a constant speed and in this way takes the representative sample.

When the usually conical vessel reaches the waiting position, the bottom flap is opened via stops and a sophisticated lever system, and the slotted vessel is emptied. The waiting position of the sampler is always outside the flow of material, which minimizes unit wear.

Advantages

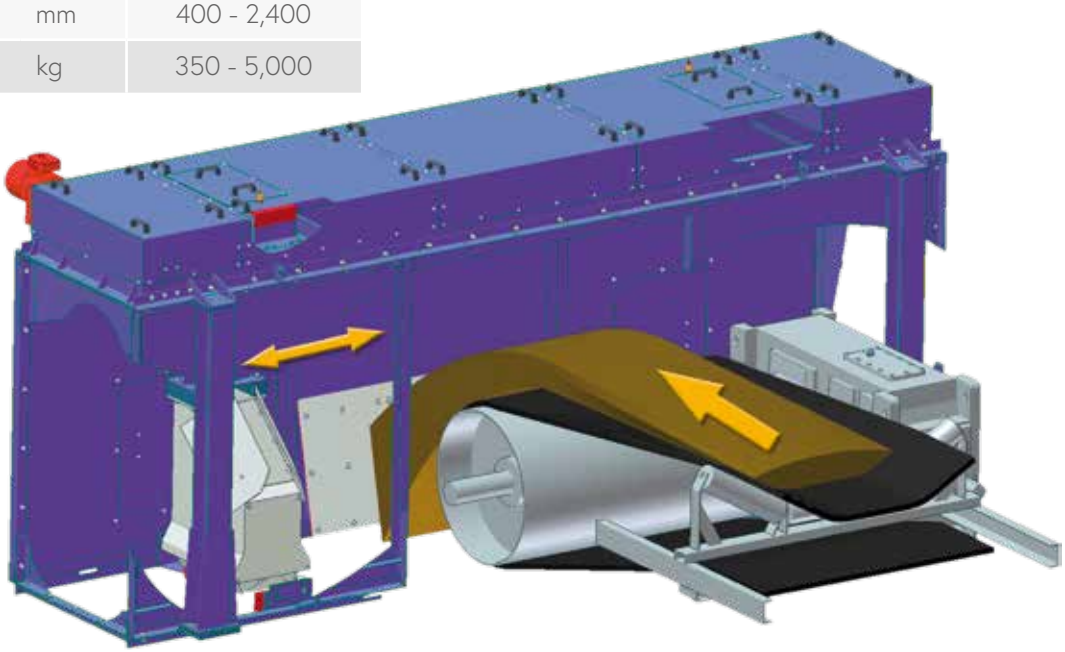
- A design that enables extremely good adaptation to the given local conditions
- The possibility of new designs to enable representative sampling even in the most inaccessible places

Slot vessel samplers in a hanging design

This version of the slot vessel sampler is available with different roadway arrangements and can therefore be adapted to many installation situations.
The guiding of the sampling spoon in a circular path also represents further design options:

- Swivel arm sampler
- Swivel sampler

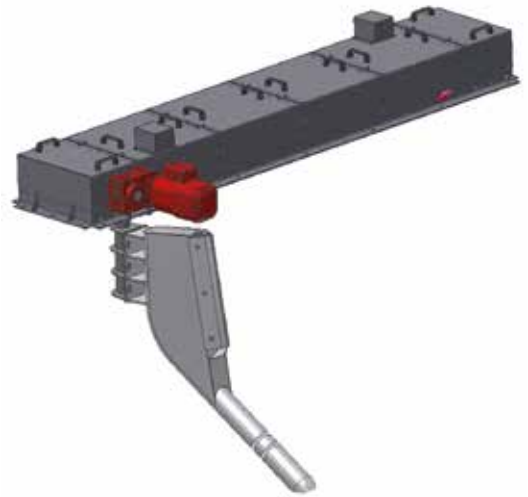
Slot vessel samlper / Swivel sampler / Swivel arm sampler		LPN / SwPN / SAPN
Belt width	mm	400 - 2,400
Weight	kg	350 - 5,000



Slurry sampler

The representative sampling of slurries is carried out by a sampling spoon, which is guided through the material flow in a linear movement at constant speed. While the sampling spoon travels through the suspension flow, a partial flow is continuously separated and discharged via the outlet pipe. The sample material obtained in this way can be collected and further processed via a collection drain channel. The waiting position of the sampling spoon between two samplings is inside the material space but outside the main product flow, so that any direct contact between the sampling spoon and the material flow is avoided and wear on the sampling spoon is reduced.

Slurry sampler		LPN-T
Pipe diameter/ cross section of chute	mm	100 - 3,000
Weight	kg	250 - 1,000

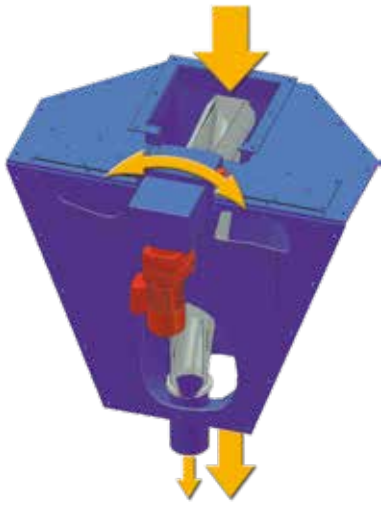


Downpipe / slurry sampler

The representative sampling is carried out by a sample chute, which is guided in a circular motion through the material flow at a constant speed. While the sample chute is rotated through the material flow, a partial flow is continuously separated and routed to the outside. The sample material obtained in this way can be collected and further processed via a pipe socket.

- The sample chute can be driven either by a gear motor or by a pneumatic cylinder.
- The distinction between downpipe and slurrysampler refers to the material flow to be sampled and has an influence on the discharge angle of the sample chute

The waiting position of the sample chute between two samplings is inside the material space but outside the main product flow, so that any direct contact between the sample chute and the material flow is avoided and wear on the sample chute is reduced.



Downpipe / slurry sampler		FPN / TPN
Nominal diameter of the downpipe	mm	200 - 800
Installation height	mm	500 - 3,000
Weight	kg	80 - 3,000

UNITS FOR SAMPLING AND SAMPLE PREPARATION

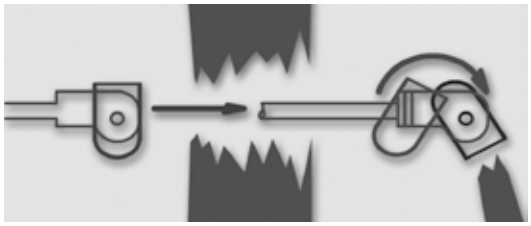
Downpipe slot vessel sampler

The representative sampling takes place by means of a slotted vessel, which is guided by a pneumatic linear drive via a round rod at constant speed through the complete chute cross section. Due to the multiple sealing of the feedthrough of the round rod and the enclosure of the drive, the drive is not directly exposed to the product and thus remains almost free of wear. The passage speed of the slotted-vessel can be adapted to individual requirements by means of adjustable valves on the drive.

The sampling spoon is rotated above the sample discharge chute and thus emptied after the slotted-vessel has passed through the product flow. The centrifugal motion is initiated mechanically via adjustable stops and therefore requires no further drive.

Setting up the slotted-vessel in the filling position, which takes place outside the product flow, is only done after the product flow has been crossed again in the opposite direction. In this waiting position the sampler is not exposed to the product flow and is therefore not subject to wear.

Downpipe slot vessel sampler		FLPN 100 - 300
Nominal diameter of the downpipe	mm	100 - 300
Installation Height	mm	450
Weight	kg	75 - 110



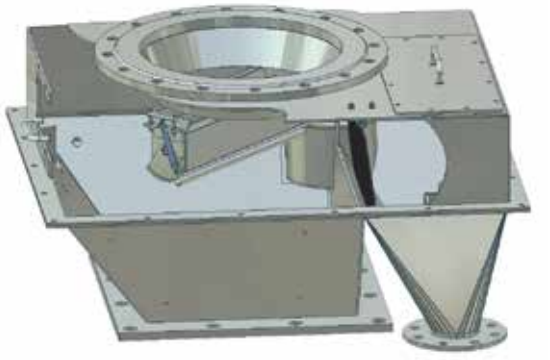
Downpipe swivel sampler

The representative sampling is carried out here through a slotted vessel, which is swivelled in a circular motion, and at a constant speed, through the material flow.

While the slotted vessel is rotated through the material flow, a sample is taken from the material flow and collected in the slotted vessel. This is then emptied by opening the movable bottom above the sample discharge chute. Following a complete discharge, the slotted vessel swings back into the waiting position.

With this sampler the waiting position is also outside the main material flow to protect the slotted vessel from wear.

The swivel movement of the slotted vessel can be carried out either by a pneumatic cylinder or by a three-phase motor.



Downpipe swivel sampler		FSPN
Nominal diameter of the downpipe	mm	400 - 800
Installation height	mm	500 - 700
Weight	kg	150 - 600

Screw sampler

The screw sampler is one of the samplers that takes a point sample from the material flow.

In order to be able to ensure sufficient representativeness here, the product streams to be sampled must be homogeneous across the different particle sizes.

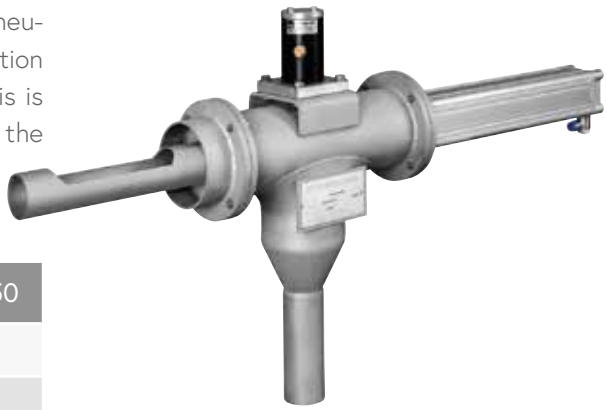
Sampling is carried out via a sample collection tube projecting into the material flow, which is provided with openings into which material can drop permanently. At the time of sampling, the auger first empties the sample collection tube in the direction of the material flow. After a defined emptying time, the worm reverses and conveys the sample material that has fallen into the sample collection pipe into a pipe socket outside the main pipe.

Screw sampler		SPN 50 / 480
Diameter of the sample collection pipe	mm	dia. 50
Sample volume approx.	dm^3/h	130
Weight	kg	20

Piston sampler

The piston sampler is also one of the samplers that takes a point sample from the material flow. In order to be able to ensure sufficient representativeness here, the product streams to be sampled must be homogeneous across the different particle sizes.

Sampling is carried out via a sample collection tube projecting into the material flow, which is provided with an opening into which material can drop permanently. At the time of sampling, a pneumatically actuated piston is pushed through the sample collection pipe from the waiting position towards the material flow. This is used to empty the sample collection pipe and then to take the newly collected sample material on the return journey. The sample material thus obtained can be transferred to a pipe socket outside the main pipe.



Piston sampler		KoPN 50 / 250
Diameter of the collection pipe	mm	dia. 50
Sample volume approx.	cm^3	250
Weight	kg	15

UNITS FOR SAMPLING AND SAMPLE PREPARATION

Clinker sampler

Like the piston sampler, the clinker sampler is one of the samplers that takes a point sample from the material flow. For this purpose, a sampling spoon, which is filled with sample material over a defined period of time, is pneumatically moved into the product flow.

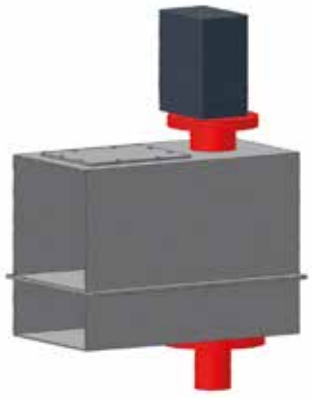
When the sampling spoon is withdrawn, it is stripped off by a piston inside the sampler housing, and the material sample is pre-classified via a rigid screen grate. The fine material obtained in this way can be transferred to a pipe socket for further analysis. The coarse parts are transferred to another pipe socket and should be returned to the main material flow.

Clinker sampler		KPN 130x600
Diameter of the sampling spoon	mm	dia. 80
Sample volume approx.	dm^3	3
Weight	kg	280

Air slide sampler

The air slide sampler is one of the samplers that takes a point sample from the material flow of an air slide. In order to be able to ensure sufficient representativeness here, the product flows to be sampled must be homogeneous across the conveying width.

Sampling is carried out via a sample collection pipe projecting into the material flow, which is provided with openings. Normally the openings are turned in conveying direction and close against a gasket. At the time of sampling, the sample collection pipe with its openings is turned against the conveying direction so that sample material can flow in. The sample material entered is ejected in downward direction via the sample collection pipe and through the air slide.



Air slide sampler		RPN 50 / 480
Diameter of the collection pipe	mm	dia. 50
Sample volume approx.	mm	250
Weight	kg	20

Comminution units

A number of machines are available in our range for the comminution of products with varying degrees of hardness:

hammer mills, double-roller mills and single-roller mills, jaw crushers, cone crushers, continuously operating vibrating-disc mills and eccentric vibrating mills for grinding to the degree of fineness required for analysis. The selection of the most suitable comminution unit is based on the product and the quality characteristic to be analysed.

Jaw crusher EB 30/25

Single-roller mill
EW 30/40-L

Hammer mill HM 6a

UNITS FOR SAMPLING AND SAMPLE PREPARATION

Dividing equipment

A wide range of equipment is available for subdividing the sample. The respective standards must also be carefully observed for the sample dividers: These include minimum gap widths, speeds below 0.6 m/s, the taking of a sufficient number of individual samples (cuts) whilst the minimum quantity is being observed, no segregation, etc.

The number of the "division ratio 1 : x", which is important for the dividing units, can be calculated for our products as follows:

$$x = \frac{d_T \cdot \pi}{SW}$$

x	Division number
d_T	Diameter of dividing circuit
SW	Slot width of the material outlet opening for the sample

Turnstile divider

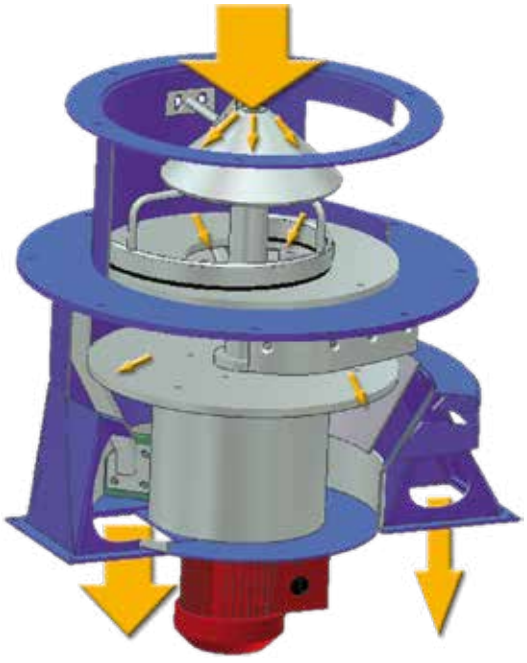
The turnstile divider is a dividing unit that, by means of minor modifications, can be used for almost all products, from coarse coke and strongly caking fine coal to finely ground quicklime.

The sampled material can usually be fed directly - without prior dosing - into the feeding area of the divider, since the inwardly directed discharge arm ensures mixing and dosing before the actual dividing stage.

The material fed to the centre of the divider plate via the first discharge arm is now uniformly transported by a second discharge arm in a spiral movement outwards over the edge of the plate. There it falls onto a conically shaped sheet metal enclosure, which is partially recessed. The product that falls into this recess is called the "sample". The material, which slides over the cone to the centre of the divider, is discharged as "reject material" via the so-called reject material channel.

Advantages

- As a result of the forced guidance of the material flow due to reliably even with moist and adhesive products.
- For regular cleaning of the dividing unit, some types can be opened up to 1/3, which increases accessibility and minimizes cleaning time.
- The division ratio can be varied in the range from 1:4 to well over 1:1000 by dimming the recess in the conical part using slide gates, depending on the divider size and design.



Turnstile divider		DKT
Diameter of the dividing circiut	mm	200 - 1,600

Turnstile divider with manual
or motor-driven adjustment of the division ratio

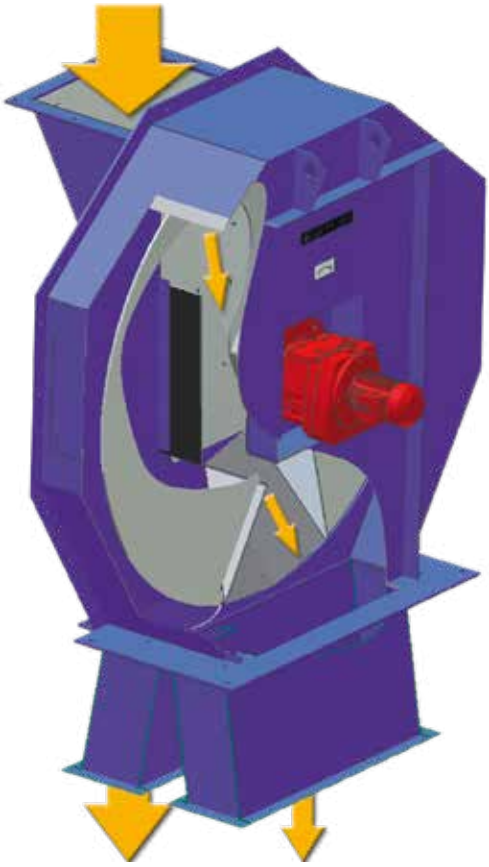
Rotary divider

The rotary divider has a vertically arranged disc with openings, which is set in rotation by a motor. The sample material is fed uniformly to the dividing unit via a dosing unit and directed onto the rotating disc. It passes through the opening in the disc as a "sample" or is rejected by the disc as "reject material".

Due to the simple design, however, the division ratio (1:2 to 1:130 depending on type) cannot be varied with this divider after manufacture.

The divider is used for dividing of continous feeded, free flowing and hardly pluging materials.

Rotary divider		ROT
Diameter of the dividing circiut	mm	400 - 1,250

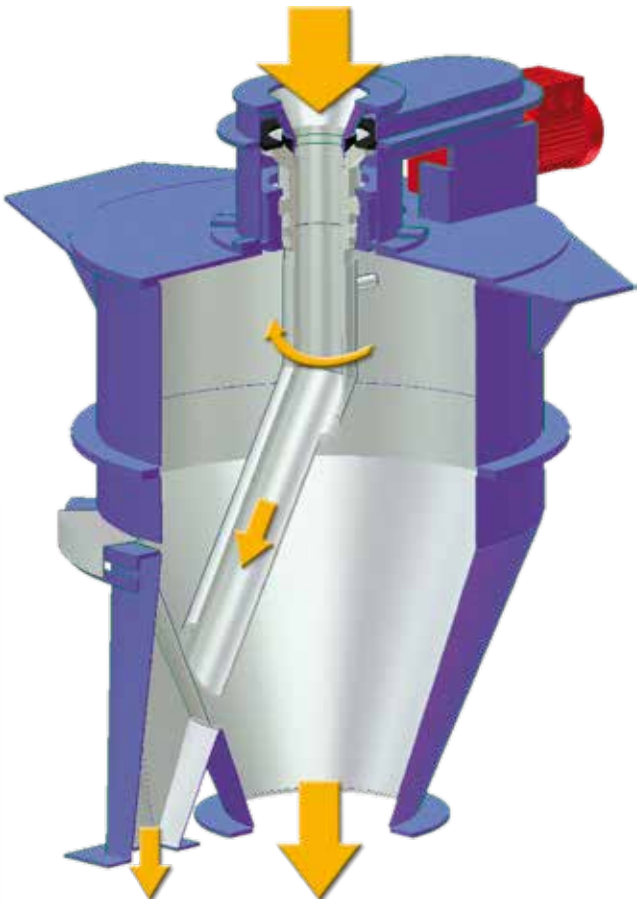


UNITS FOR SAMPLING AND SAMPLE PREPARATION

Revolving tube divider

In the revolving tube divider, the uniformly feeded material flow is distributed via an inclined rotating tube onto a funnel-shaped cone. This has recesses in the reference circle. The product that passes through this recess is designated as "sample" and the material collected by the funnel is designated as "reject material". The openings for the sample can be dimmed by means of slide gates, whereby a variably adjustable division ratio is achieved.

The revolving tube divider can be used with free flowing material that hardly tends to plug. Large inspection openings make this dividing unit easy to clean.



Revolving tube divider		DRT
Diameter of the dividing circiut	mm	200 - 1,000

Dryer

In our dryer bulk material samples are dried gently so that at the end of the drying process a dry, non-caking, free flowing sample material is available. This sample can be used for particle size analysis or further grinding to the degree of fineness required for analysis.

The drying process is based on contact drying of a tumbling hot plate, which permanently circulates the bulk material sample. In combination with infrared heating, samples can be reliably dried in a very short time.

Sample collectors, sample transport and laboratory equipment

If samples can only be collected at longer intervals, we offer the possibility of storing them in so-called sample collectors of various sizes until collection.

Our sample collectors are available in the following versions:

- as sample collectors with one or two sample containers
- as a carousel version with 4 to 20 and more sample containers
- as a roller conveyor version with 4 to 20 and more sample containers

The sample containers can hold from 0.1 to 1000 dm^3 of sample material and are optionally made of plastic or stainless steel.

All our sample containers can be fitted with RFID chips for better tracking and clear identification of the samples. If a sample container is equipped with this chip, this can be written over in a contactless fashion with the desired sample information in the sample collector. These can be easily read out in the laboratory using an appropriate device.

In the further program you will find equipment for the transport of the samples, such as space-saving and fully encapsulated special belts, equipment for sieve analysis, equipment for drum tests and other laboratory equipment for the preparation of the samples to analysis samples.

Robot-based systems for sample processing and analysis

With our robot-based sample processing plant and analysis systems, we free the laboratory from routine analyses and relieve employees from constantly repetitive tasks.

With robot-based systems, sample processing can be made more flexible and can be planned for the future. This is because changing requirements for analysis will also require more flexible sample processing procedures in the future.

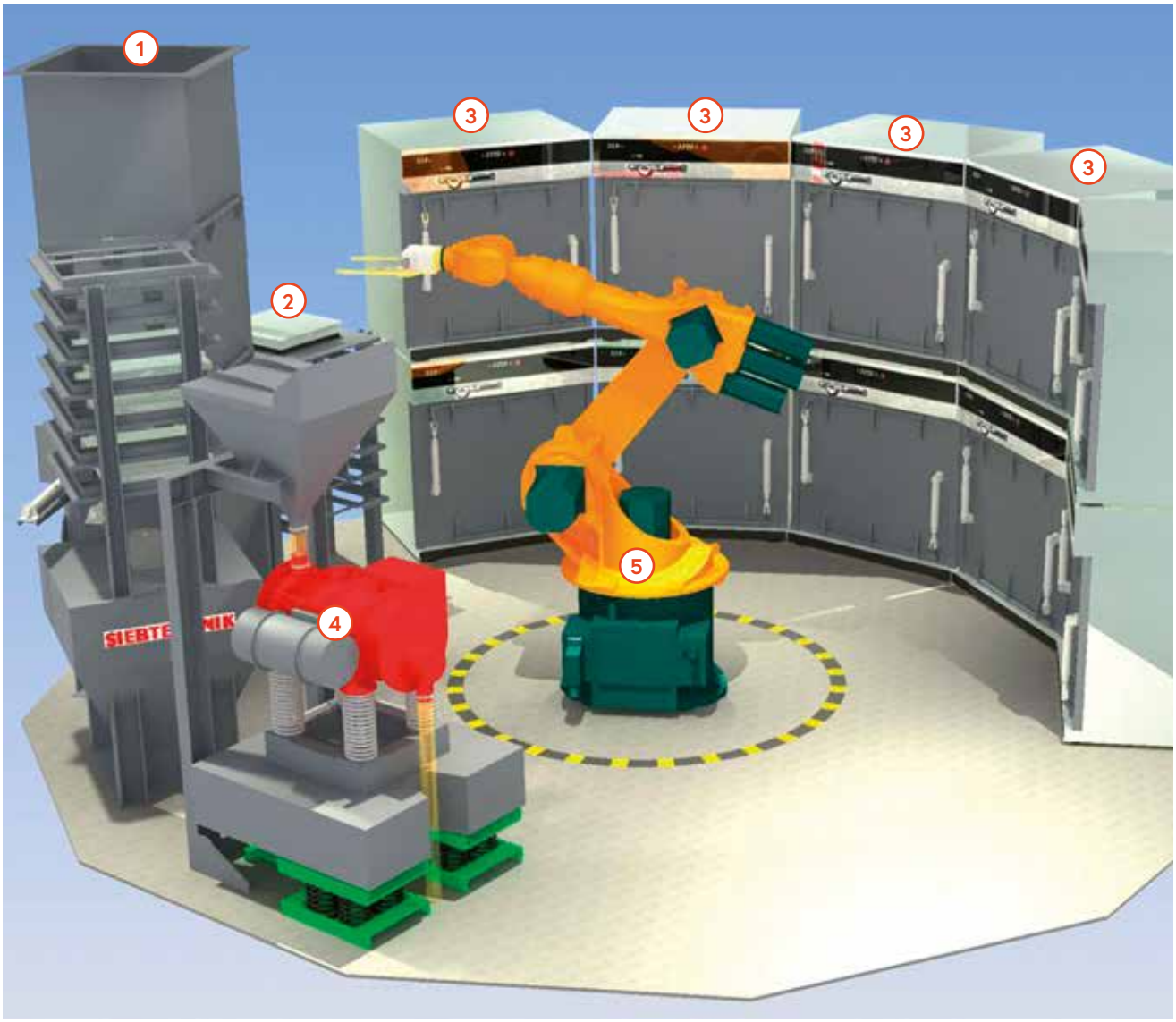
AMAS (Automatic Moisture Analyser System)

With this fully automatic system, the material moisture of bulk material samples with individual weights of up to 6 kg can be determined. For this purpose, AMAS can be integrated into an automatically operating sampling system, so that the analysis is also carried out promptly after sampling.

The process in the AMAS begins with the filling of the drying tray with the moist bulk material sample, which is then uniformly distributed and weighed in the tray. After a defined drying time, the tray is removed from the oven, weighed and put back into the oven.

This last step is repeated until the material is dried and two successive weighings show weight constancy. After emptying and cleaning the tray, it can be refilled.

In the illustration shown, AMAS is supplemented with an eccentric vibrating mill for ultra-fine comminution, so that the sample material is subsequently prepared such that it is ready for analysis.

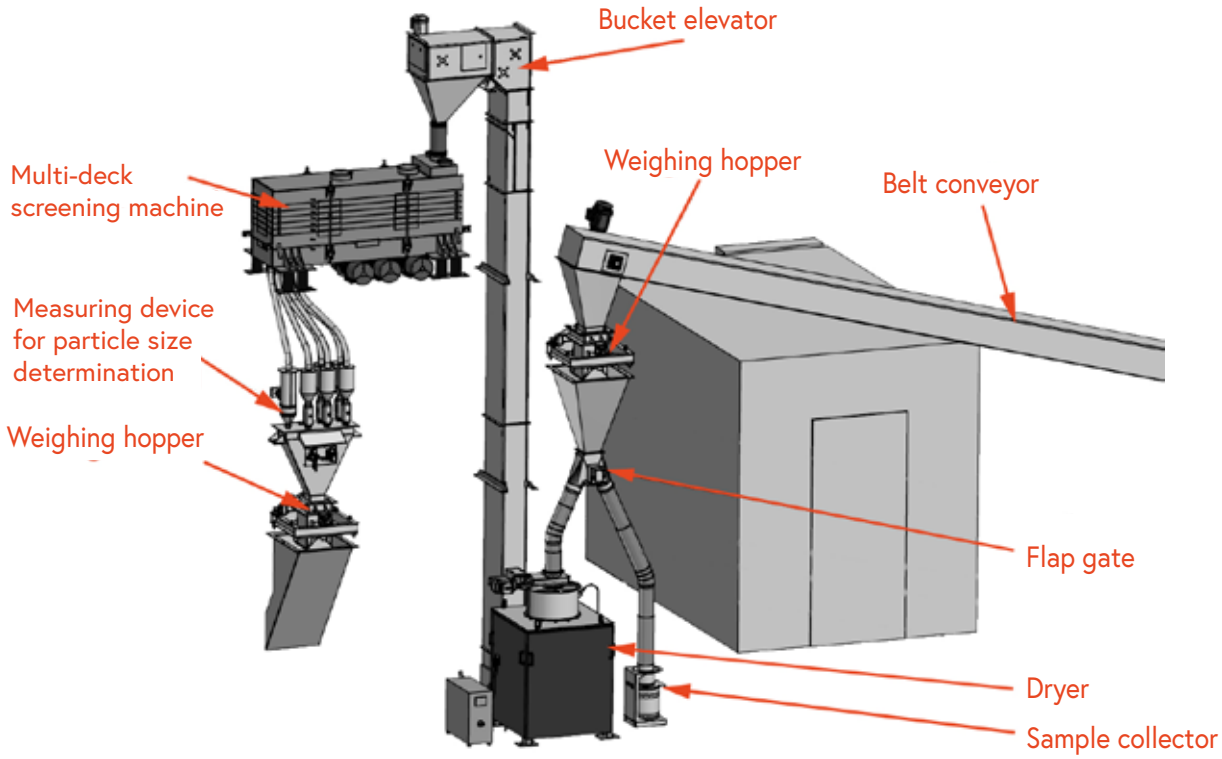


Material feed (**1**), scale (**2**), drying ovens (**3**), ultra-fine comminution (**4**), handling device (**5**)

Sampling of bulk materials with automatic particle size determination

Sample preparation systems in connection with screening machines or measuring devices for particle size determination allow the fully automatic analysis of the particle size distribution of the bulk material and simultaneously provide a sample for chemical analysis.

Due to the bulk material dryer integrated in the system, any moist products, and even wet products, can also be processed so that they can subsequently be fed to the analyser as identifiable individual particles.



Testing of sampling and sample preparation equipment

Testing a sampling system for systematic errors is very time-consuming and personnel-intensive and is usually carried out on the basis of comparative sampling. Here, the samples obtained by the automatic system are compared with those obtained by a reference procedure - manual sampling from the stopped belt.

Based on the experience of our long-standing employees, automatic sampling systems are designed in such a way that the individual devices used are selected and constructed with the necessary care and technical knowledge to produce reliably a representative analysis sample.

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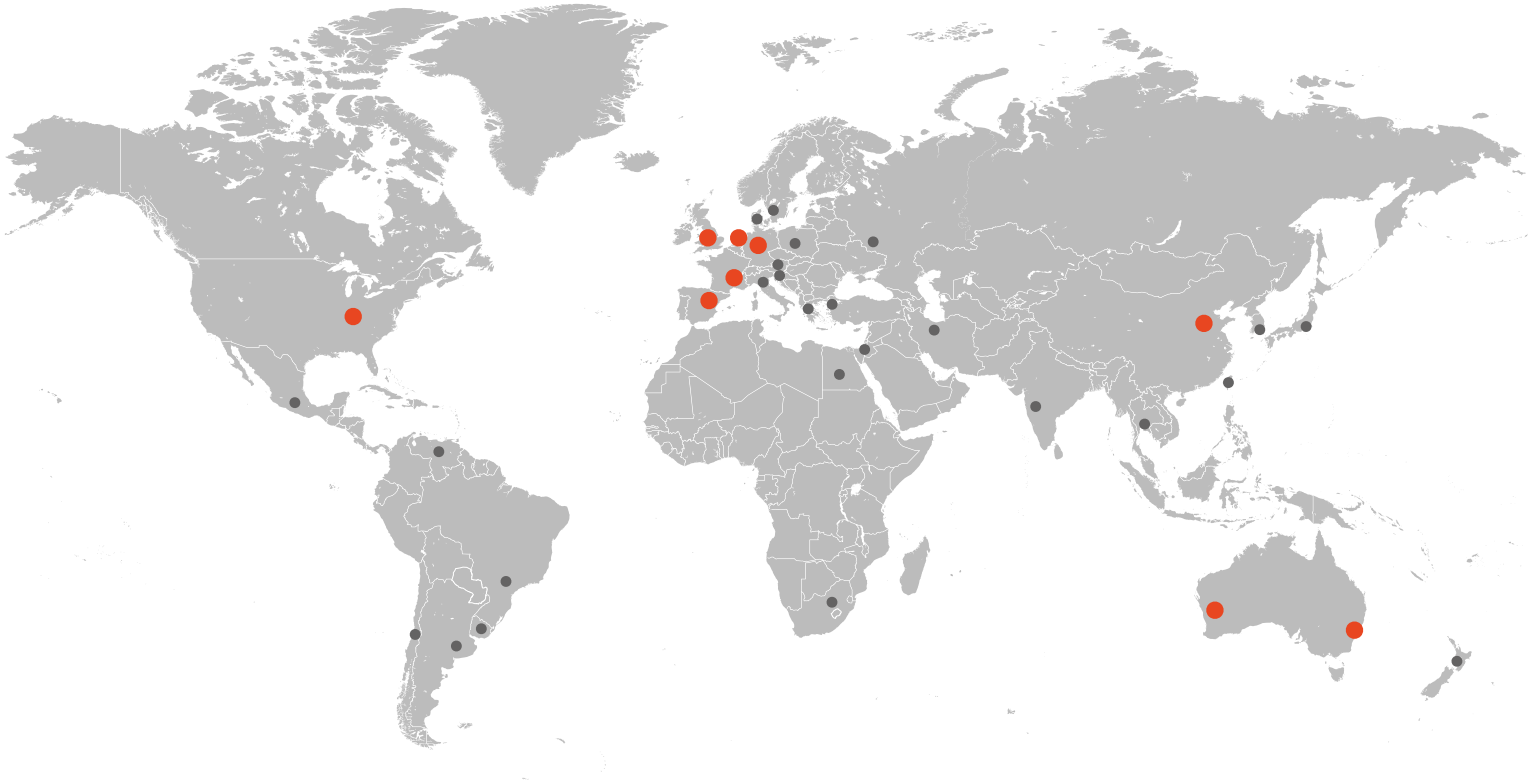

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