Slurry sampling

Outotec slurry sampling

Sampling from process streams and delivery to analyzer is crucial in process monitoring. Information on the process pipe, flow rates and the amount of sample required, determines the sampler type. Sample line routing and sizing are essential for proper operation and high availability of the analyzer system. The location of the slurry sampling from which sample is selected is based either on gravity or pressure flow, although sometimes both options are available. Closeness to the analyzer location is an advantage.

The sampler location and correct installation, has a significant effect on sample representativity. Determining the sample type is based on the purpose, which the sample required for and what is the destination of the process stream, and if sampled material being sampled contains significant amounts of trash, rocks, grinding balls or acid.

Benefits

- **High availability**
- **Low maintenance**
- **Representative sample for on-line analysis**
- **Representative sample for composite analysis**

Outotec

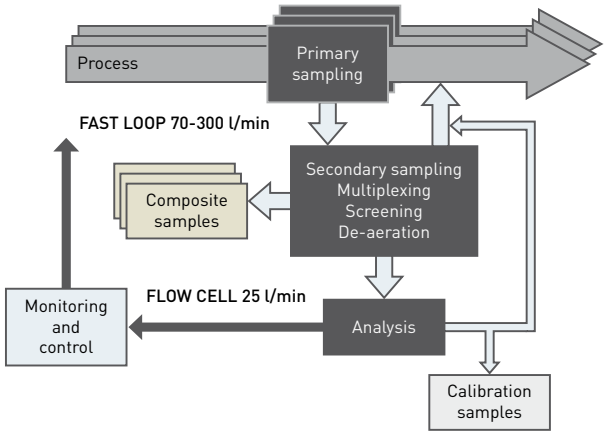
Representative sampling

Homogeneity and mixing of process flows

All material in a process flow must have the same probability of entering the sample. Turbulent flows are required in typical process streams to maintain the slurry in suspension (speed >1.5 m/s). Turbulence keeps the slurry well mixed in contrast to dry solids on a conveyer belt. The finer and lighter the solids in the slurry, the more ideal is the mixing. Gravity begins to play a significant role, when particles are above 100 µm in size and/or are of high SG material. Mixing is still very effective in the horizontal direction. Such mixing enables the use of samplers with a simple robust fixed cutter to acquire a representative sample.

Sampling for on-line analysis

An acquired sample must be representative of the characteristic of the process stream being measured. Therefore, broad-range particle size analysis requires a representative sample in respect to the particle size, while elemental analysis has to be representative in respect to the measured elemental composition.



In vertical pressure pipes, a round nozzle in the middle of the pipe can be used to extract a sample, the flow being thoroughly mixed after a pump or a suitable length of vertical pipe (i.e. longer than 10 x pipe's diameter). In horizontal gravity pipes or launders, vertical cutters are used to take an equal slice of all horizontal layers, which might have different contents due to segregation by gravity.

Isokinetic sampling

For the correct representation of all particle sizes, the flow velocity of slurry into a cutter or nozzle must be about the same as the velocity of the bulk flow around the cutter or nozzle. If the sample flow into the cutter or nozzle is too high, the sample will be biased with fine material. Differences of ±1 m/s are permissible for slurries of normal particle size range.

Primary samplers for pressure flow

Representative sampling of process flows under pressure is possible when the sample pipe diameter, length and routing are correctly designed.

When the process stream to be sampled is under pressure, the primary sample flow is determined by the balance between sampler pressure head and sample pipe friction. Standard size nozzles are used in samplers. Isokinetic samples are obtained by correct sample pipe diameter, length and routing.

Advantages

- Gives representative sample from well mixed process flow
- In most cases, no extra pump is required to move sample to the analyzer or composite sampler

Limitations

- Sample flow rate is not directly proportional to process flow for composite sampling

A PSA pressure pipe sampler with an optional automatic VSA valve set for flushing. PSA samplers are typically used at pump outlets.

ASA: To divide small pressure flows. A sector sampler can be delivered to take 25, 50 or 75% of the process flow.

SPSA straight pressure pipe sampler. Where it is inconvenient to use a PSA sampler in conventional vertical position.

HCS : To divide small horizontal flows. One primary sample flow can be divided between two analyzers using a HCS sampler.

A SPA suction pipe sampler for sampling a flotation cell discharge box, with an automatic VSA valve set for flushing.

Process location	After pump or long vertical pipe	After pump or long vertical pipe	Horizontal pipe, no froth	Horizontal pipe	Flotation cell discharge box
Flow-rate	>600 l/min	<600 l/min	>500 l/min	<500 l/min	All
Pipe size	>100 mm	⩽100 mm	>100 mm	⩽100 mm	N/A
Sampler type	PSA pressure pipe sampler (or SPSA)	ASA sector sampler	SPSA straight pressure pipe sampler	HCS sector sampler	SPA suction pipe sampler
Note		Can take 25, 50 or 75% of flow	Can also be used for vertical pipes	Can split sample between analyzers	
Sample use	Analysis Composite	Analysis Composite	Analysis	Analysis Composite	Analysis

Primary samplers for gravity flow

When the process stream is essentially at ambient pressure, a vertical sample cutter can be used. The cutter opening must be many times larger than the maximum particle size of sampled slurry, at least 8 mm, but preferably >20 mm. The gravity primary sample flow is not restricted, ensuring isokinetics at the sampling point. The sample flow can be adjusted using an adjustable cutter opening for pipe sizes up to 400 mm.

The sampler box design improves process flow mixing prior to the sample cut. When representative isokinetic sampling is applied, high process flows produce large primary sample flows, which requires many sampling steps or innovative sampling designs.

Advantages

- Takes a representative sample from a vertically segregated process flow
- The sample flow rate of single stage samplers is directly proportional to the process flow for composite and accounting sampling

Limitations

- A pump may be required to transport the sample to the analyzer or composite sampler

Two stage samplers for large process flows

Single stage sampler produces too high sample flow-rate from a large process flow. Two stage samplers are able to provide a suitable sample flow-rate for on-stream analysis.

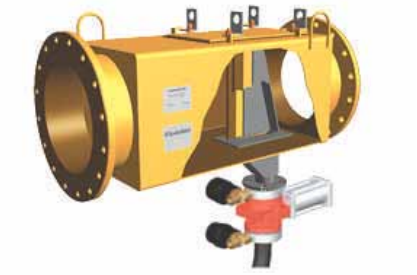
A CPS two stage sampler for high speed process flows. The sample entering the tube is re-sampled using a controlled syphon sampler.

A SKA vertical cutter sampler for process flows under ambient pressure in a launder.

A TSC two stage vertical cutter sampler for large process flows under ambient pressure. The sampler can be installed at a launder bottom or in a LSA style sampling box.

Process location	Nearly horizontal gravity pipe or launder, no froth	Gravity flow in launder	Nearly horizontal gravity flow
Flow-rate m^3/h	>350	<1000–2000	<1000–2000
Pipe size	≥250 mm	N/A	N/A
Sampler	CPS primary sampler	SKA vertical sample cutter	TSC two stage vertical cutter sampler
Note	Two stage sampler. Requires control from analyzer. Restricted sample flow.		Two Stage Cutter allows broader cutter opening than LSA/NLA
Sample use	Analysis Composite	Analysis Composite Accounting	Analysis Composite

NLA non plug vertical cutter sampler with automatic mechanical cutter cleaner for ambient pressure process flow containing trash. Victaulic process pipe connections.



A LSA vertical cutter sampler with an optional VSA automatic flushing valve set for process flows at ambient pressure. A cyclone overflow is a typical LSA sampling point.

Process location	Nearly horizontal gravity pipe	Nearly horizontal gravity pipe
Flow-rate m^3/h	25–1000– (1600)	25–1000– (1600)
Pipe size	⩽600 mm	⩽600 mm
Sampler	LSA or NLA vertical cutter sampler	LSA or NLA vertical cutter sampler
Note	Flow >1000 m^3/h requires a partly blanked cutter	Flow >1000 m^3/h requires a partly blanked cutter
Sample use	Analysis Composite Accounting	Analysis Composite Accounting

An ASD adjustable sample divider located on top of a PSI 500™ analyzer multiplexer, allowing a large primary sample flow to be used for easily settling slurry.

Process location	Horizontal pipe	Sample line
Flow-rate m^3/h	<30	6–18
Pipe size	⩽100 mm	50 mm
Sampler	HCS sector sampler or LSA 80	ASD 50 adjustable sample divider
Note	Can split sample between analyzers	Reduces primary sample flow and splits sample
Sample use	Analysis Composite Accounting	Analysis Composite Accounting

Metallurgical accounting sampling

Metallurgical accounting

Accounting samples must represent the variations that occur in both process flow and solids content, in addition to requirements for on-line analysis. Strictly speaking, a pressure pipe sampler with restricted sample flow, cannot produce a sample suitable for accounting purposes.

MSA Multi-stage Metallurgical Accounting Sampler

Operation of the sampler is based on a combination of static multiple cutter stages (depending on the process flow), followed by a moving crosscut sampler stage, which produces the sample. The MSA samplers can handle process flows from 60–18,000 m³/h.

The MSA sampler can be configured to deliver a composite sample or a continuous flow of about 150 l/min, which is suitable for Courier® and PSI analyzers. Analyzer controlled sampling by the MSA samplers is also possible.

Composite sampling and filtering

The final composite sample is taken from the 150 l/min primary sample flow by the secondary sampler in the Courier® on-stream analyzer system, by a LMC 50 or 80 linear moving cutter composite sampler or by a SSA 50 stand-alone composite sampler.

The composite sample can be filtered using an optional VFU vacuum sample filter unit. The VFU is self-contained, equipped with a vacuum blower and uses standard filter papers.

LMC 80 linear moving cutter composite sampler.

A composite sampler SSA 50 with sample filter and vacuum blower.

A MSA 3/140 metallurgical sampler with a pipe outlet.

Model	Nominal capacity m³/h	Stages	Number of static cutters	Main launder width mm	Sample use
SSA 50	6–18	1	1	50	Accounting
LMC 50	6–18	1	none	50	Accounting
LMC 80	18–60	1	none	80	Accounting
MSA 1/40	60–180	1	none	400	Analysis Accounting
MSA 2/50	180–600	2	3	500	Analysis Accounting
MSA 2/80	600–1800	2	4	800	Analysis Accounting
MSA 3/140	1800–6000	3	5/3	1400	Analysis Accounting
MSA 3/200	6000–18000	3	5/4	2000	Analysis Accounting

Controlled sampling

Controlled primary sampling

On-stream analyzers have traditionally used continuously flowing primary samples. Controlled sampling is a built-in feature in new generation Courier® analyzers. The analyzer can have an active role in controlling the primary sample acquisition and delivery to the analyzer. Remote controlled sample valves are required and the desired sampling sequence has to be configured. A combination of continuous and controlled sample lines can be used in the same analyzer system.

On-demand sampling

Analyzer scheduler starts the primary sample flow some time before the next measurement and/or composite sampling. After measurement the sample flow is stopped and the sample cutter and sample line are flushed with water. This radically improves the availability of samples and reduces the volume of returned samples.

Automatically flushed sample lines

The primary sample usually flows continuously, but is interrupted at programmed intervals to flush the sampler nozzle or cutter and the sample line. The flushing is scheduled not to interfere with normal measurements and composite sampling cycle.

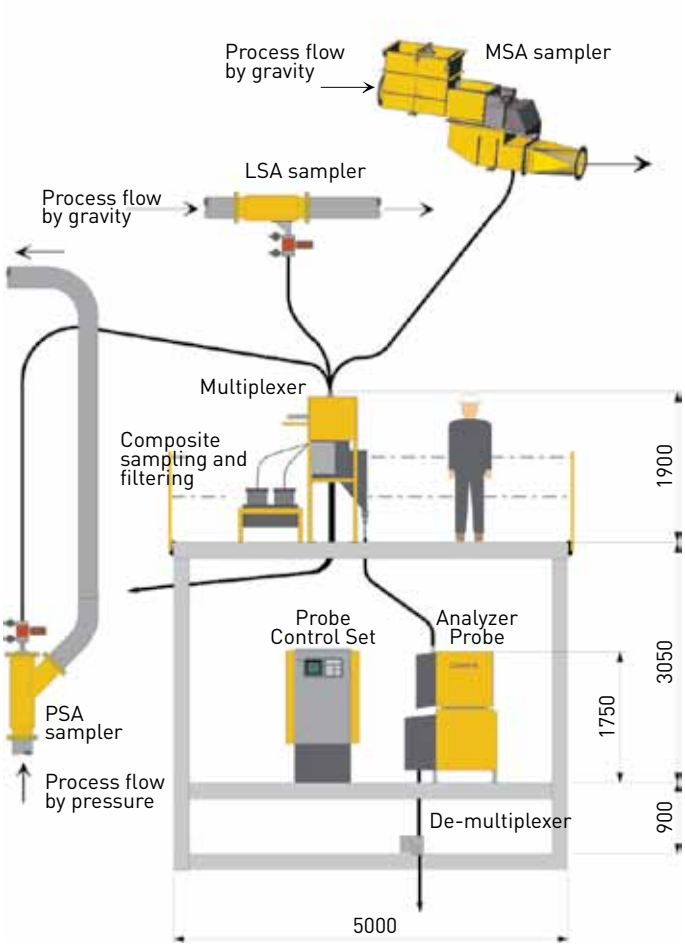
Options

Flanges:
DIN 2576, AS 2129–TABLE D, SABS 1123–TABLE 10, ANSI B16.5–150 lbs, Victaulic

Lining:
Natural rubber as standard, other materials as an option

Cutters:
Wear areas rubber lined, hard metals and ceramics as options

Sample valves:
Manual and automatic flush valves are available



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Outotec develops and provides technology solutions for the sustainable use of Earth's natural resources. As the global leader in minerals and metals processing technology, Outotec has developed over decades several breakthrough technologies. The company also offers innovative solutions for the chemical industry, industrial water treatment and the utilization of alternative energy sources. Outotec shares are listed on the NASDAQ OMX Helsinki.

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