QCX cement works
sampling points
Sampling points in a cement plant

Raw Materials
Check of chemical and mineralogical composition of the raw materials for quarry planning, pile mixing control, mill and kiln operation as well as cement quality:
- Elemental analysis by XRF of samples from exploration or blast hole drillings
- Mineral composition by XRD or Microscopy
- Elemental analysis by PGNAA of feed streams to stockpiles
- Moisture content of feed streams.

Automation options
- On-line PGNAA & QCX/BlendExpert-Pile

Typical raw materials for cement production:
- Limestone, chalk, marl
- Clay, shale, bauxite
- Quartz sand, sandstone
- Laterite, iron ore, pyrite ash
- Fuel (coal, oil, gas, petcoke, waste)
- Cement additives: Gypsum, limestone, slag, pozzolana, fly ash.

Typical routine sampling points for the cement making process

- Raw meal
- Filter dust
- Hot meal
- Raw mill feed
- Kiln outlet/Hot clinker
- Clinker
- Finished cement
- Dispatch
- Coal/Fuel
- Mixing bed
- Raw materials
**Raw mill feed**
Check of chemical composition of raw materials.
- Elemental analysis by PGNAA

**Automation options**
- On-line PGNAA with QCX/BlendExpert-Mill.

**Raw meal**
Quality control of raw meal and control of mill operation:
- Elemental analysis by XRF (1-2 per hr)
- Particle sizing by sieve or laser (1 per 2 hr)
- Moisture content (1 per 4 hr)
- Burnability

**Automation options**
- Aut sampling & aut sample transport to lab
- QCX/BlendExpert-Mill.

**Filter dust**
Check of chemical composition, material balances (e.g. K, Na, S, Cl):
- Elemental analysis by XRF (1 per 24 hr)
Automation normally not considered.

**Kiln feed**
Consistency between raw mill product, kiln feed and clinker analyses, material balances (e.g. K, Na, S, Cl), silo blending efficiency, burnability, heat consumption:
- Elemental analysis by XRF (1 per 1-2 hr)
- Particle sizing by sieve or laser (1 per 4-8 hr)
- Heat of reaction
- Burnability

**Automation options**
- Aut sampling & aut sample transport to lab.

**Hot meal**
Dust separation efficiencies, dewatering and degree of calcination, material balances (e.g. K, Na, S, Cl), silo blending efficiency, fuel burn-out:
- Elemental analysis by XRF
- Loss on Ignition

**Automation options**
- Aut sampling & aut sample transport to lab. Automation is valuable due to health and safety issues with hot meal handling.

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**Coal/Fuel**
Check of coal mill operation, fuel consumption, ash absorption in clinker, material balances (e.g. K, Na, S, Cl), burn–out in calciner, NOx –formation:
- Calorific value, moisture, gas, ash % (1 per 8-24 hr)
- Elemental analysis of ash (1 per 8-24 hr)
- Particle sizing by sieve or laser (1 per 2-4 hr)

**Automation options**
- Aut sampling & aut sample transport to lab.

**Clinker**
Check of clinker quality and kiln operation, material balances (e.g. K, Na, S, Cl):
- Elemental analysis by XRF (1 per 1-2 hr)
- FCaO analysis by titration or XRD (1 per 1-2 hr)
- Mineral composition by XRD (1 per 2-8 hr)
- Litre weight (1 per 1-2 hr) (alternative to FCaO)

**Automation options**
- Aut sampling & aut sample transport to lab
- Both sampling of clinker directly after the kiln for fast analysis and after the cooler is available
- Automation is valuable due to health and safety issues with hot clinker handling.

**Finished cement from mill**
Control of gypsum and additives, check of mill operation as well as quality of the finished cement:
- Elemental analysis by XRF (1 per 2-4 hr).
- CO₂/SO₃ analysis by combustion (1 per 2-4 hr)
- Particle sizing by sieve or laser (1 per 1-2 hr)
- Specific surface area (Blaine), density (1 per 1-2 hr)
- Mineral composition by XRD (1 per 2-4 hr)
- Thermal analyses (dewatering of Gypsum, Wk)
- Physical testing of cement properties (1 per 24 hr)

**Automation options**
- Aut sampling & aut sample transport to lab
- QCX/BlendExpert-Mill.

**Dispatch**
Verification of cement quality before despatch, to test against possible damage during silo storage and for issuing of customer certificates:
- Analyses and tests: The same as for finished cement

**Automation options**
- Aut sampling & aut sample transport to lab.

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**NORMAL CEMENT SAMPLING & ANALYSIS SCHEME**

<table>
<thead>
<tr>
<th>Samples &amp; analysis per 24 hours</th>
<th>Samples</th>
<th>XRF</th>
<th>XRD/(FCa0)</th>
<th>Blaine</th>
<th>Particle sizing</th>
<th>Other</th>
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<td>Hot meal</td>
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<td>12-24</td>
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<tr>
<td>Coal/Fuel</td>
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<td>Depending on fuel type</td>
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<td>Cement dispatch</td>
<td>According to QA scheme in plant</td>
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