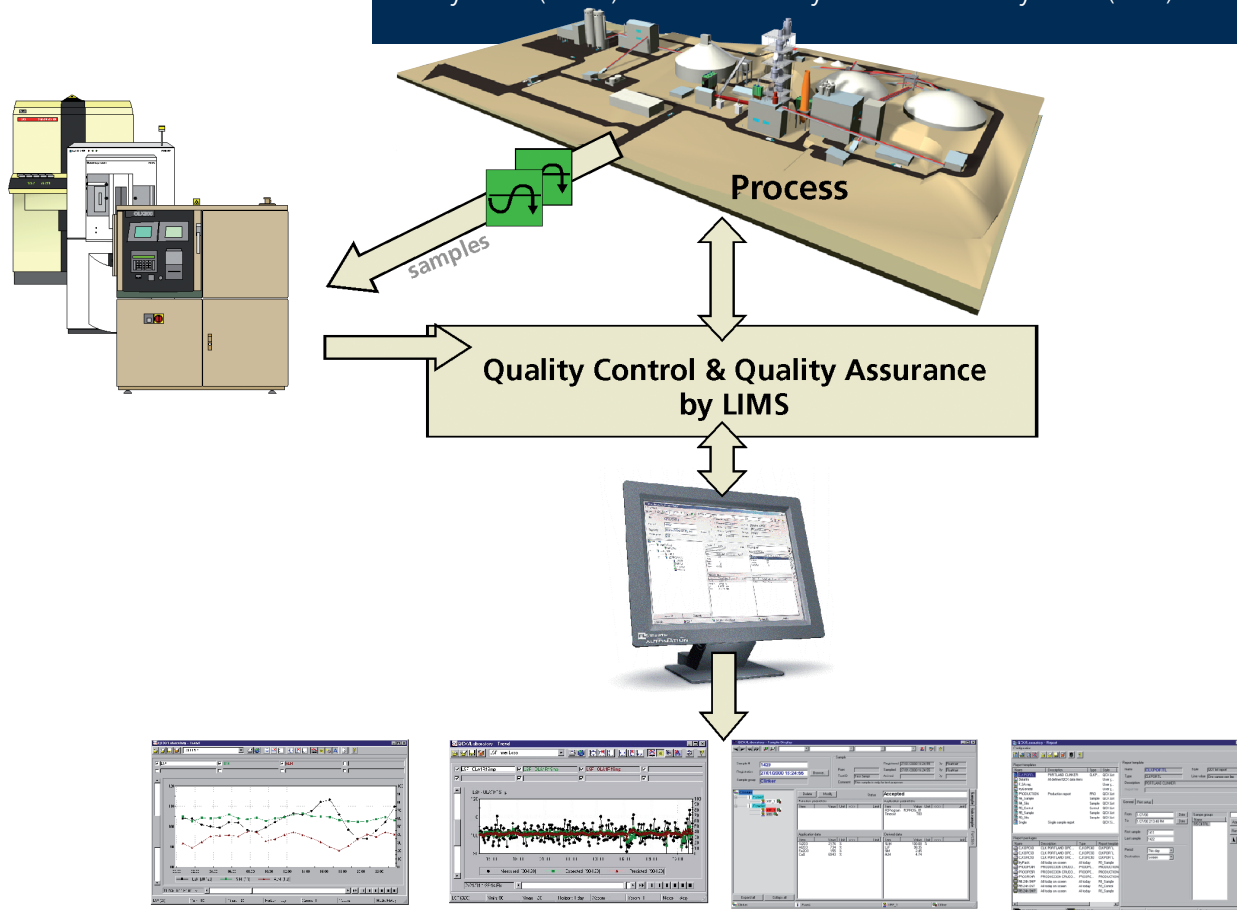
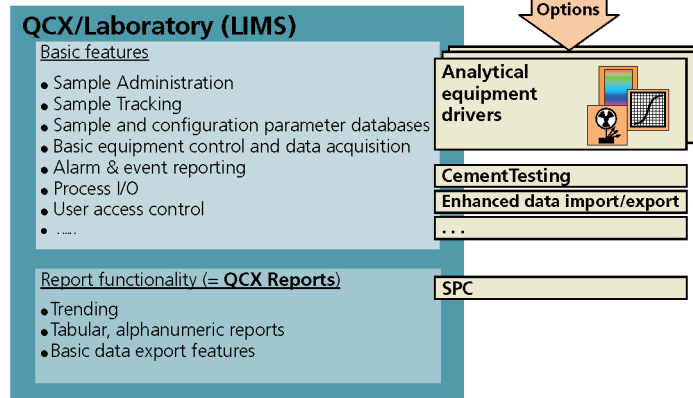


QCX/Laboratory™

– a unique combination of a Laboratory Information Management System (LIMS) & a Laboratory Automation System (LAS)



LIMS: Laboratory Information Management System



LAS: Laboratory Automation System

Application

QCX/Laboratory supports a wide range of Quality Assurance (QA) & Quality Control (QC) aspects at all relevant stages of a minerals processing operation. QCX/Laboratory is a kernel module of every QCX system and provides basic software functionality such as sample administration, sample tracking, sample data base, data import/export, user access control, equipment control, data capture and report generation facilities. The module is delivered with interface drivers for the project specific selection of sample preparation equipment and/or analytical instruments.

QCX/Laboratory combines state-of-the-art LIMS and LAS functionality with emphasis on procedures for the routine production laboratory. The applied software platform allows for easy and efficient combination of analytical data with on-line process data for a variety of process optimization applications. A wide range of utilities and facilities complemented by various individually priced options supports flexible customization of single steps in the LIMS/LAS procedures. Likewise, on-demand development of special facilities can be arranged for.

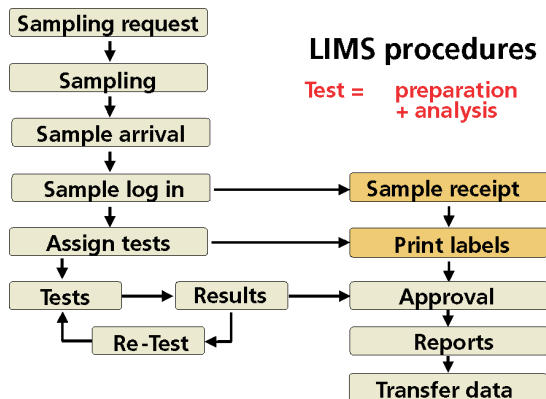
- manually initiated via uniform operator interfaces
- Easy integration with process control systems
- Emphasis on simple and intuitive procedures
- Compliance with international QA standards
- Comprehensive utility functions
- Support for barcode technology
- Customized automation of limit check, approval and validation

Available options include "SPC" providing statistical process control facilities and "Enhanced data export/import" functionality, explained in detail further on. The "Cement Testing" data handling option offers a total data-handling concept supporting all data required for e.g. the ASTM or En29001 norms for physical testing of cement products.

Equipment control and data acquisition

In the form of so-called equipment drivers QCX/Laboratory offers automatic equipment control and/or data acquisition for a wide range of analytical instruments:

- XRF X-ray Fluorescence Spectrometers
- XRD X-ray Diffractometers
- PSZ Particle Size Analyzers
- BLN Specific Surface Analyzers (Blaine)
- OES Optical Emission Spectrometers (Spark or ICP)
- CSH Carbon/Sulphur/Hydrogen Combustion Analyzers
- COL Colour Analyzers
- CST Cement Strength Testing equipment
- and many more



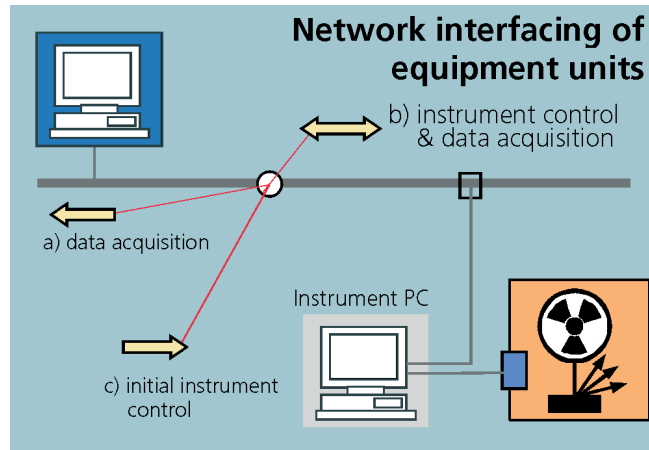
Software features and modularity

Other QCX application modules can be integrated with QCX/Laboratory in any combination. As outlined in the illustration above, the basic functionality offers comprehensive analytical support and associated LIMS&LAS features. Pending the requirement for analysis data reporting QCX/Laboratory can be delivered in a scaled down version, where the standard "QCX Reports" functionality have been excluded. Such a configuration may become relevant if the QCX system exports all data generated to a 3rd party LIMS. Developed with emphasis on the routine production laboratory and automation aspects, FLSmidth Automation's unique integration of LIMS and LAS offers:

- High flexibility on equipment selection and configuration
- Support for any degree of automation
- Automatic analysis data capture and instrument control or

Equipment units such as crushers, mills and presses for X-ray powder sample preparation can also - pending the specifications for the individual units - be interfaced from QCX/Laboratory. Today, most newer analysis instruments are interfaced via a dedicated PC, but the link may be direct. One example of interfacing via PC's is for XRF spectrometers: This communication set-up implies that procedures for calibration, monitor analysis, stability tests etc and special instrument checks (and remote service) are performed from the X-ray suppliers application software package (e.g. "WinXRF", "SuperQ", "XPertIndustry", "X.40", "Spectraplus", "XPertEase"). In this typical set-up the QCX system transfers relevant sample ID & analysis parameters during analysis start-up and later picks up the calculated analysis upon completion of the analysis sequence.

The automatic data capture/instrument control facilities are complemented by utilities for manual analysis data insertion & administration (by sample, by batch, by instrument or by group of instruments).



Sample Groups

To simplify and streamline the use of QCX/Laboratory in a production laboratory environment, the concept of Sample Grouping is used. A Sample Group is normally associated with a material that should be sampled, prepared and analyzed in an identical way on a routine basis. Normally each possible combination of sampling location and product type makes up one Sample Group, which can be regarded as a folder in the system, organizing data from samples with certain characteristics in common. Samples within a sample group:

- are taken at the same location in the process
- relates to one particular product type
- normally undergoes identical split into sub-samples
- normally undergoes identical preparation and analysis procedures for each sub-sample, but specific sub-sample tests may be suppressed every n^{th} time
- has the same data acceptance rules applied

The data associated with each Sample Group outlines the defined treatment (= preparation, analysis, data handling etc.) corresponding program(s) and associated parameters to be used. The equivalent LIMS term often referred to is "method".

QCX/Laboratory is delivered configured with the project specific number of Sample Groups. The basic software license supports 50 Sample Groups, and can be expanded by add-on licenses adding multiples of 50 Sample Groups. For "mix control only" or other special applications, where QCX/Laboratory shall only administer sample data for a few sample groups, a "light" version of QCX/Laboratory is available.

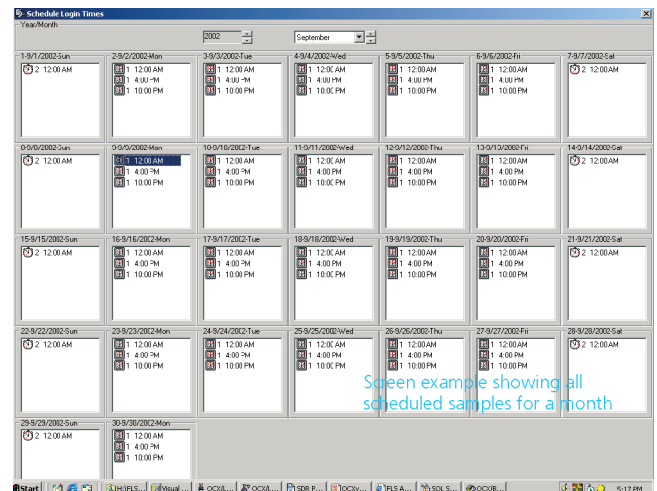
Sample Log-in/Log-out

In accordance with the LIMS concept any sample to be handled/or processed by any functionality of the system must first become known to the system, e.g. it must be logged-in. Samples can be logged-in manually by the operator as single samples or batches simply by clicking in a screen window, but normally samples are logged-in automatically:

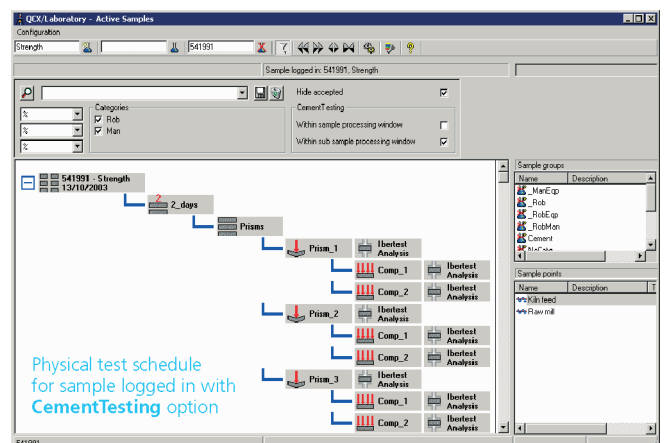
- Automatic login according to the routine sampling scheme (optionally interlocked so that log-in occurs only, if referred process status point shows normal operation).
- Automatic or operator assisted analysis assignment for logged-in samples

With QCX/AutoSampling included automatic login naturally takes place at the true registered time of sampling. At the time of log-in, the predefined analytical tests and associated parameters are assigned to the sample corresponding to its Sample Group. The operator therefore need not specify anything unless he wants to modify the default method assigned to the Sample Group.

When required, the operator can assign tests and analyses at leisure to a specific sample in connection with the log-in procedure. Any sample can be manually logged-out by the operator when desired. Furthermore, a sample with all specified tests and all data accepted will be logged-out automatically. To prevent overflowing the "stack of active samples" aged samples are logged-out following a first-in first-out principle, but any aged logged-out samples may naturally be logged-in manually again.



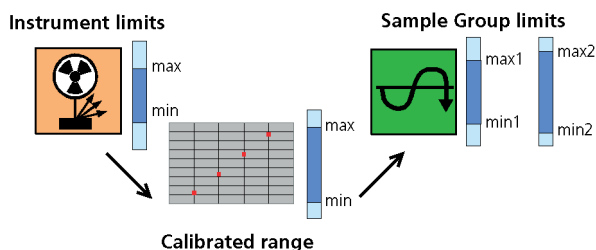
The optional CementTesting utility supports advanced sample log-in in accordance with international norms for physical testing of cement. This option supports automatic re-logging of samples at the due test times, e.g. after 3,7,28 or 56 days for compressive and bending strength tests of the sub-sample specimens.



Data acceptance

Careful screening of automatically generated data before eventually being passed on for on-line process control applications is vital for the control performance. The basic standard facilities of QCX/Laboratory include extensive data acceptance and data validation options designed to work under any degree of automation. Up to 4 data limit checks are applied:

Data acceptance criteria



It can be defined which actions are to be taken if a violation is detected; as an example for a violation situation it could be defined to register the value but not pass it on for a relevant control application, or an alarm calling for operator attention could be generated. Data approval, validation or editing is supported in accordance with the implemented user access control facilities. Thus, normally only authorized personnel can access these priority functions, and it will be reported "who did what at which time". But, if so desired the system can be configured to disable all protection and "tell tale" facilities.

Reports, trends and data import/export

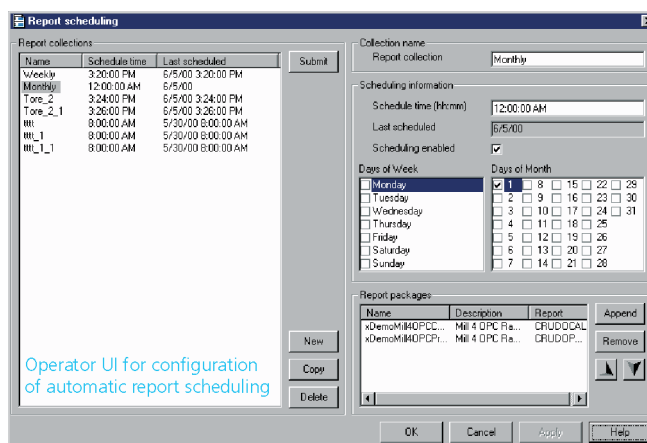
QCX/Laboratory comes with a comprehensive list of several hundred predefined data items for various analytes/instruments and data registration entities. Items can be added or modified (e.g. to local language). So-called composite values (calculated from other analytes) are supported by sets of pre-defined formulas (e.g. Cement "modules") and by a formula editor for adding to or editing the predefined formulas.

The basic QCX Reports facilities includes extensive and flexible report generation capability provides for daily, weekly, monthly and "free period" reports in accordance with user specified reporting schemes. In the typical configuration the (optional) link to the process control system allows for useful combination reports of lab and process operation data. Alphanumerical "column style" reports, tables and graphic charts - on screen, on paper or to file - are supported with high flexibility in layout. One of many features for graphic charts is that time delays can be associated any trended data item, so that process related delays for one entity through a process can be compensated in a multi curve graph. The "to file" report generation facilities provide a flexible way of getting selected QCX data exported from the QCX system to external data processing. The "to file" destination can be anywhere on the network environment, and several data formats such as "Access", "Excel", "flat ASCII", "HTML" etc are supported. The set-up can be configured to export single sample data and/or average data for a day, week or month. Data export can take place ad hoc via operator activation or automatically on a clocked frequency, and will then comprise the selected data within the report package time period, e.g. this day, this week, last day etc. Ad hoc export of historic data can take place at any time with free definition of period. Since the QCX SQL database holds all generated data for minimum 2 years, this means fast

access to a vast amount of historic sample data. The standard reporting facilities also include event logging, limit violation monitoring and logging of data modifications. SPC (statistical process control) data handling and related data presentation utilities including control charts are supported via the optional "SPC" package.

More sophisticated facilities are available with the enhanced import/export features, which are optional. These features are for instance recommended for time critical missions, where automatic data export is requested as an event driven feature, e.g. acquired or modified data are exported immediately after they have been generated. Also when completion of sample data are spread over a long time period (for example physical testing), the enhanced import/export features are required for 100 % consistency in the data export. The enhanced export option stores data in an "output tray", which is a set of tables in a dedicated SQL database. A qualified PC user can easily pick-up the data in this output tray. This is our recommended solution for customized data export solutions, and is also the concept used in cases where FLSmidth Automation have supplied customized solutions to specific 3rd party LIMS'es in use with corporate cement producers. Likewise the enhanced data import features supports customized import of data from a 3rd party LIMS or alike.

Finally, the open system environment, e.g. Microsoft/ActiveX technology based on DCOM including OLE Automation interfaces and the open SQL database concept means that a qualified PC user can access and report in his own way any data in the QCX system. However, an important note of concern here: the SQL databases residing on the QCX Server PC are components of an integrated dynamically operating system with certain time critical operations. Due to the open software environment, users with adequate skills cannot be denied access to the data. As the safest approach for users with such intentions, and in order not to affect overall system performance, FLSmidth automation recommends to work on a replicated version of the QCX SQL database.



© FLSmidth A/S Automation. All rights reserved.
 ECS/ProcessExpert, ECS/CEMulator, ECS/PlantGuide, QCX/RoboLab, QCX/OnStream, ECS/CemScanner, ECS/ACESYS, ECS/ControlCenter, ACE/Woodware, ECS/SmartStation, ECS/StackGuide, QCX/Laboratory, QCX/AutoSampling, QCX/AutoPrep, QCX/BlendExpert, QCX/BlendMaster and Kinloq are either registered trademarks or trademarks of FLSmidth A/S Automation in the United States and/or other countries. All other trademarks are property of their respective owners.

FLSmidth Automation reserves the right to change specifications without prior notice. Our 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. Please contact us for specific information or data that may relate to your interests.