SIMATIC BATCH
Automation of batch processes with SIMATIC BATCH

SIMATIC PCS 7 always offers the right solution for attractively priced and effective implementation of batch processes:

- Simple batch processes with parameterizable sequential controls are automated using the SFC and CFC tools included in the engineering system.
- SIMATIC BATCH with recipe-guided operation enables easy and flexible processing of complex tasks with varying control sequences.

Modular architecture

SIMATIC BATCH can be configured as a single-user system or as a client/server system, and can be used in plants of any size thanks to its modular architecture and scalability in multiple steps with 10, 20, 40, 100 and unlimited units (instances of plant units).

For small applications, e.g. for laboratory automation, SIMATIC BATCH can also be combined with the PC-based starter system SIMATIC PCS 7 BOX 416. The capacity of SIMATIC BATCH is limited to 10 units in this case.

However, characteristic for the automation of batch processes using SIMATIC BATCH are client/server architectures with which one batch server and several batch clients process a plant project together. The batch server can also be configured with redundancy in order to increase availability.

Integration in SIMATIC PCS 7

SIMATIC BATCH is fully integrated in SIMATIC PCS 7. Connection to the production management level is supported through direct communication with SIMATIC IT, the Manufacturing Execution System (MES) from Siemens.

The plant data can be configured entirely using the engineering system. This passes on all data required for recipe creation to the batch server, making recipe processing possible separate from the engineering system. Changes to the configuration which are made on the engineering system are available to the batch server using an update function.

The batch server software usually runs on an autonomous server hardware (batch server), separated from the OS servers. Depending on the capacity utilization of the Operator System, OS and batch server software can also be operated on shared server hardware (OS/batch server). SIMATIC BATCH clients and OS clients can run on separate or common basic hardware.

SIMATIC BATCH uses the SIMATIC logon integrated in the Process Control System for central user administration and authentication, as well as for the "electronic signature" to release basic recipes, formulas, and library objects through enabled Windows users/user groups. Individual configuration settings of the Batch Control Center and recipe editor are saved as a user-specific profile when logging off. This means that you can work in a familiar environment as soon as you log on again at any client in the plant.

Communication with the automation systems

SIMATIC BATCH communicates with the automation systems (AS) through the PCS 7 operator system (OS). Operator instructions and dialogs can also be integrated into the communication. For small applications AS, OS and SIMATIC BATCH can be concentrated in one SIMATIC PCS 7 BOX 416.

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SIMATIC BATCH provides special faceplates for controlling and monitoring plant units and equipment modules. As a rule, instances of an SFC type are used as the interface to the lower automation level.

**Batch control center**

The batch control center (BatchCC) is the "command center" for monitoring and controlling batch processes with SIMATIC BATCH. Using BatchCC it is possible to manage the data relevant for SIMATIC BATCH from a GUI. BatchCC offers powerful functions for the following tasks:

- Reading in and updating the plant data of the basic automation
- Definition of user privileges for all functions, for clients, or for plant units of SIMATIC BATCH
- Definition of material names and codes
- Management of master recipes, and starting the recipe editor in order to enter the recipe structure
- Management of libraries with recipe elements (library operations)
- Exporting and importing of basic recipes, formulas and library objects
- Editing of formula categories and management of associated formulas (parameter sets)
- Creation of batches with master recipes
- Starting of batch processing and controlling of batches
- Monitoring and diagnostics of batch processing
- Changing assignment strategy and plant unit assignment online during batch runtime
- Recording and archiving of recipes and batch data

**Batch planning**

BatchCC enables the creation of individual production orders and batches. A greatly increased planning functionality is offered by the batch planning option package with which the batches can already be planned in advance for a large number of production orders.

In addition to planning, the scope of functions include the modification, cancellation, deletion and enabling of batches. Creation and distribution of the batches for a production order are possible manually, but can also be carried out automatically depending on definition of the batch number or production quantity.

All batches including their occupation of plant units can be clearly presented in a combination of Gantt diagram and table. Time conflicts or those resulting from multiple occupation of plant units are identified by symbols. Time conflicts can be eliminated simply by shifting the associated batches in the Gantt diagram.

Until enabled, the following batch properties can be set and modified:

- Quantity
- Start mode (immediately, following operator input, or time-controlled)
- Occupation of plant units
- Formula (parameter set)
- Execution sequence (linking to previous or subsequent batch)
- Display of planned runtime for a batch
Recipe Editor and Batch Report

Recipe editor

The recipe editor is a user-friendly tool for the easy, intuitive creation and modification of basic recipes and library operations. It has a GUI, processing functions for individual and grouped objects, and a structural syntax check. The basis for recipe creation are the batch objects created from the batch plant configuration using the SIMATIC PCS 7 engineering system, e.g. plant units and technological functions. The Batch Recipe Editor can be called from BatchCC, or it can be started individually.

The following tasks can be performed with the recipe editor:

- Creation of new basic recipes and library operations
- Modification of existing basic recipes and library operations (changes to structures or parameters)
- Querying of statuses of the recipe objects and of process values in transition conditions
- Assignment of route control locations to the transport phases as transfer parameters (source, target, via), in order to direct products of one batch into other plant units
- Documentation of basic recipes and library operations
- Checking the plausibility under inclusion of user-specific plausibility checks
- Selection of plant unit candidates through limitation of equipment properties
- Releasing basic recipes and library operations for test or production
- Configuring arithmetic expressions for calculating setpoints for transitions and recipe parameters from recipe variables and constants

Batch report

The batch report function integrated in BatchCC is used to produce recipe and batch reports. These can be displayed and printed using BatchCC or the separate report viewer.

Batch reports

The batch reports contain all data required for reproduction of the batch process, for proof of the quality, and for compliance with statutory directives. These include, for example:

- Identification data
- Control recipe data
- Effective production data
- Time sequence of steps
- Status messages, fault messages and alarms
- Operator interventions
- Process values

Recipe reports

The recipe reports contain the production data, e.g.

- Recipe header data
- Recipe topology
- Used material, rejected material and parameter lists
- Procedure directives
Hierarchical and plant-unit neutral recipes

Hierarchical recipes according to ISA-88.01

SIMATIC BATCH and SIMATIC PCS 7 form a functional unit that fully covers the models described in the ISA-88.01 standard. The hierarchical recipe structure is mapped on the plant module as follows:

- Recipe procedure for controlling the process or the production in a plant
- Partial recipe procedure for controlling a process step in a plant unit
- Recipe operation/function for the process engineering task/function in an equipment module

Neutrality and assignment of plant units

Creation of a recipe which is neutral to the plant unit minimizes the engineering overhead and provides significant advantages for validation. During creation of the recipe, the partial recipe procedures are only assigned plant unit classes. The final assignment of the plant units is only carried out during runtime. In the cases of batches which run for a longer period and where the plant units are not to be already determined and occupied at the start of a batch, the assignment is only carried out at the time of use. Conflicts in the occupation of plant units are detected by the system, and displayed.

The following occupation strategies for plant unit assignments permit optimum orientation according to the special plant situation:

- "Manual selection of plant unit" for preselection at time of recipe creation
- "Preferred plant unit" for preselection at time of recipe creation
- Determination of "Plant unused for longest time" to achieve uniform utilization
- Assignment of plant unit to be used by means of "Process parameters" from external module (e.g. scheduler)

The occupation strategy can also be modified during the batch runtime, just like the plant unit assignment.
Rationalization, logging, validation

Separation of procedure and formula

The flexibility achieved by recipes which are independent of plant units can be increased even further if the procedure and parameter sets (formulas) are separated from one another. Various master recipes can be created by linking several formulas using a recipe procedure. This enables central modification of procedures. The formula structure is determined by the formula category defined by the user.

Validation according to 21 CFR Part 11

The number of plants which have to be validated for observance of quality standards because of marketing and statutory requirements is permanently increasing. The process control system and its manufacturer play an important role in the validation procedure.

SIMATIC BATCH particularly supports validation according to 21 CFR Part 11 through:

- Consistent standardization, e.g. with
  - Type-instance concept of SFC
  - Recipe creation independent of plant unit
  - Separation of procedure and formula
  - Library recipe operations
- Audit trail (modification logbook):
  - Recording of changes in recipes and recipe operations (saved with modified object)
  - Recording of changes during production (in the batch report), including the operations of the individual control level belonging to the corresponding batch
- Free and system-supported versioning of recipes, recipe operations, formulas and library elements
- Central user administration with access control through SIMATIC Logon
- Electronic signature for release of master recipes, formulas and library objects based on SIMATIC Logon

Furthermore, Siemens as a manufacturer of process control systems has specially trained personnel as well as many years of experience in quality management and plant validation.

Application Programming Interface (API)

The SIMATIC BATCH API application programming interface is an open interface for customer-specific extensions. To program special industry-specific or project-specific applications it offers the user access to data and the functions of SIMATIC BATCH.
SIMATIC BATCH highlights

- Modular architecture with flexible scalability (hardware and software)
  - Optimum adaptation to plant size and individual requirements
  - Grows with the plant configuration; no expensive spare capacities

- High availability thanks to redundant batch servers
  - No loss of batch data
  - Automatic matching of batch data

- Homogenous integration of SIMATIC BATCH into the HMI strategy and the engineering of SIMATIC PCS 7 via system interface
  - No customized interfaces
  - No double configuring for batch-specific engineering data

- Recipes independent of plant unit
  - Great simplification in recipe management and validation
  - Flexible operation and optimum plant utilization through modification of occupation strategy and assignment of plant units during batch runtime

- Hierarchical recipes according to ISA-88.01
  - Creation of recipes oriented according to process engineering
  - Quick, easy and fault-minimizing creation

- Importing and exporting of master recipes, formulas and library objects

- Saving, archiving and comprehensive reporting of batch data in XML format
  - Production becomes transparent and comprehensible
  - Reliable operator prompting, safe response to process faults

- Reduction in engineering and validation overhead through:
  - Type/instance concept of SFC
  - Separation of procedure and formula
  - ROP library and configuration independent of plant unit
  - Multiple usage, central modification

- Validation support according to 21 CFR Part 11 through:
  - Audit trail (modification logbook)
  - Free and system-supported versioning
  - Libraries with recipe operations and formulas
  - User administration with access protection and electronic signature

- Direct connection to the MES system SIMATIC IT via internal system interfaces