“Totally Integrated Automation - From the batch plant through the hot house to further processing”
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Abstract
Not long ago computers and programmable logic controllers (PLC), operator and control system, centralised and distributed automation configurations, factory and process automation were used for different tasks within an plant. It was quite normal, that island solutions were multiplying the expenses for service, spare parts and training. The integrity of complex data had to be checked with high expenses. Configuring and programming of system components had to be made via different engineering tools and commissioning had a high demand for resources.
Siemens found a new way to create better customer benefit. This article will describe the general solution, the Siemens philosophy of Totally Integrated Automation and shows the effect of this new approach on glass plant automation by looking exemplary at a float glass factory.

Float glass production calls for a totally integrated automation solution
Float glass plays an important part in many areas of our everyday life. Manufacturers of glass for the car industry or the building trade, safety glass, glass for solar panels and the like need to cater for a wide variety of quality specifications and customer requirements. More stringent environment protection conditions and new thermal insulation regulations are forcing European Manufacturers in particular to think about new production methods – a challenge also for research scientists, mechanical engineers and suppliers of automation systems.
New findings on the composition of the glass batch and the melting and shaping processes must be put into practice. The energy consumption of the glass melting process is so great that it needs to be subjected to strict economic criteria. And primary and secondary steps have to be taken to bring the pollutants in the exhaust gas down to within the statutory limits.
The float glass production process can be split roughly into the sectors batch plant, furnace, float bath with the top rollers, annealing lehr, cutting line and utilities (see Fig. 1). Arrangements for the interfaces to the automation systems to be used should be made with the suppliers of the machinery right at the planning stage for a float glass factory. Integration is of the utmost importance – from the mixing of the glass batch to the finished product from the mechanical engineering point of view, and from field level to company management level on the automation side. Float glass production requires a constant, interruptible flow of material for the duration of an entire furnace campaign. Optimum control of this calls for an equally unified, totally integrated automation solution.

Overcoming System Barriers
What we really need is a modular system, which allows the realisation of solutions, which are technical needed and also wise from a commercial state of view. Existing system barriers must be overcome.
The heart of Totally Integrated Automation by Siemens is the threefold integration of data management, configuring and programming, and communication. For example every SIMATIC component has this unique property of threefold integration.
Totally Integrated Solution encloses techniques like programmable logic controller, decentralised periphery, operator systems, communication networks and process control systems, single and redundant. The complete company’s automation environment is integrated. Open interfaces allow links to commercial data processing applications and third party systems.

Each task executed with SIMATIC results in a visible reduction of engineering costs, an avoidance of system barriers within the automation environment and the benefit of one Software basis for all components. The SIMATIC Industrial Software, based on Windows(TM) 95, Windows NT and UNIX(TM). Open, standardised networks make the connection to non-Siemens automation components - from the field level to the management level and from the production area into the office environment.

**Cutting overall costs**
The overall costs of automation solutions have reached a level which in many cases presents an obstacle to progress. The original purchase price of a system is only one factor of many - and is usually not the most important. Many expenses are not encountered until the system is up and running: software modifications, changes, interface management, training, after-sales service and spare parts stocking for systems which are not totally integrated. This sends costs spiralling - and often puts the brakes on productivity. This is where Totally Integrated Automation from Siemens comes in.

It can increase the productivity during project implementation, reduces engineering costs and the life cycle costs of the complete automation system. It even reduces hardware costs drastically in the process industry. Totally Integrated Automation reduces the costs for maintenance and training and facilitates adaptation to changing market demand. It is based on recognised communication standards and uses the standards of PC technology.

And Totally Integrated Automation provides a simple, almost cost-neutral migration option. The investments of users are well-protected.

Third-party products can be integrated because all components of Totally Integrated Automation are based on standards for open interoperation. But, the higher the proportion of Siemens components in a total automation solution, the greater the degree of integration and the larger the cost benefits.

**Threefold integration**
Totally Integrated Automation in Data management means that data are only entered once, and are then available on a factory-wide basis. If the data are required at another location (at the PLC or computer end of the visualisation system, or by a distributed I/O station) the software fetches the data from the shared database. Complex data integrity checks are eliminated.

Totally Integrated Automation in Configuring and Programming means that all components and systems that belong to the same solution are configured, programmed, started up, tested and monitored with a single totally integrated and modular software toolbox. The user interface is always the same, and exactly those tools that are best suited to the user and the task are used. The visualisation software SIMATIC WinCC contains all the main functions required for the visualisation of machine and plant states and the display of process sequences in pixel-graphics. If add-on applications are required (e.g. for maintenance or the monitoring of industrial processes), they can be included easily using the standard integrated interfaces (DDE, OLE, ODBC or SQL).

Totally Integrated Automation in Communication means, for example, to configure a PLC without knowing which network it will use to communicate with other PLCs. This is because the selection of the network is only one of the selection criteria involved in configuration. "Who communicates with whom" is defined simply in connection tables, and the connections can be changed at any time at any location. This means that a distinction no longer has to be made between centralised and distributed configurations. Third-party products can be integrated over standardised software interfaces and standardised networks, because Totally Integrated Automation is open.

Communication is becoming more and more the key feature. Because an increasing diversity of components, ranging from the simplest sensor to the most complex process control system, are required to exchange data with automation systems in order to achieve an ever-increasing degree of automation. The demands on the communications network are just as diverse. High-performance networks for the field and process levels as well as for office systems have established themselves here. Totally Integrated Automation favours, in each case, the system that is recognised as the international standard: i.e. PROFIBUS, Industrial Ethernet and AS-Interface. These networks are now setting the standard world-wide in openness, flexibility of communications and frequency of implementation.
Totally Integrated Automation in the glass industry

The Siemens solution for float glass industry is based on the product range of SIMATIC PCS7, the process control system in Totally Integrated Automation. The uniform process control (local and central) in all areas of the process makes the job of the plant operating staff easier in every way (see Fig.2).

Figure 2: Plantwide Automation and Drives Solutions with Totally Integrated Automation

The graduated performance levels and the design permit individual expansion of existing automation systems. The integration of distributed I/O and intelligent modules via PROFIBUS-DP reduces the cabling overhead. This philosophy covers the complete plant. MICROMASTER frequency converters, which are used in the batch house to control induction motors, are integrated into the automation system via PROFIBUS. SIMOVERT MASTERDRIVES, used as converter systems in the warm area, allow simple bus links for special drive solutions, well suited to Totally Integrated Automation. At the cold end SINUMERIK SIMODRIVE Controls are covering the full range of CNC automation tasks by providing optimum quality, also integrated into the general automation of the plant. Measurement of flow and pressures is performed via SITRANS P and PROFIBUS-PA, an extension of the PROFIBUS-DP, which permits applications in potentially explosive atmospheres and powers field devices simultaneously via the data line.

The weighing and batching system SIWAREX M with verification capability for maximum accuracy requirements is integrated into SIMATIC PCS7, linked via PROFIBUS.

The human machine interface for the operator(s) uses the SIMATIC WinCC software package with additional instrumentation and control functionality. Uniform process control is equally possible from the local operator station or from a multi-terminal system using Windows NT. Time-synchronised automation and operation ensure that messages are evaluated in the correct sequence. High-security operator identification is provided by chip cards. The operator can view several sections of the process at the same time, using only one keyboard or mouse. Archiving functions (including external storage) facilitate production documentation for the purposes of ISO 9000.

Current process values can be printed out on a colour printer. OLE and ODBC standardise data communication with company management level.
The software can be modified on-line without interrupting operation. Video pictures from systems monitoring the furnace chamber or the top rollers, for example, give the plant operators a constant overview of what is going on. The on-line language switchover facility is also helpful for foreign plant operators. Displaying the sequence control system (reversal) enables errors to be detected quickly and accurately. The entire automation system, from glass batch store to cutting line, is configured and documented using an engineering system in an user-friendly Windows environment in accordance with international standards. The system has powerful import/export functions for adopting data from CAE tools and its wide functionality and ease of use bring a significant reduction in engineering overheads.

Every part of the automation system, from the smallest local unit to operator stations with multi-terminal capability, can be configured completely via bus from a single station with this engineering system. The SIMATIC Manager gives a functional and technological view of the automation objects and provides a management and copying function that can also be used for simulation and testing. There is an integral library containing a broad spectrum of software blocks ranging from fully tested, simple basic blocks to blocks for process-related functions. Using these blocks saves a lot of time and ensures accurate, reliable configuring.

And - there is also extensive support for migration from previously installed process control systems, such as TELEPERM M, SIMATIC S5 and COROS or SIMATIC PCS.

Summary
From a technological point of view Siemens Totally Integrated Automation means to overcome existing system barriers by integrating all devices in one general automation solution. The heart of Totally Integrated Automation is the threefold integration of data management, configuring and programming, and communication, concerning the whole plant. All hierarchical levels from human machine interface up to the fieldbus are based on one united system.

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