Pictures: Siemens; [M]-Frank

The Route Control takes into account the running time of the conveyors. This facilitates overlapping transport of material in cascaded conveyors, and creates a noticeable increase in productivity for the whole plant.

Automated route control boosts productivity

Siemens software avoids operator headaches on a complex materials handling network

Optimized route control helps to implement even very complex and extensive material transport tasks quickly, flexibly and economically, as shown here using the example of a lime manufacturing plant. At the same time it improves plant efficiency and product quality, and reduces the operators' workload, enabling them to concentrate on more productive tasks.

Roland Wieser and Christian Trips

"Through the use of standardized route control for automatic transport of materials we were able to significantly reduce the workload for the operators."

Kristijan Rajic, project leader at Rheinkalk

Lime is all around us. It is used, for example, in the manufacture of windows or wall plaster, for cleaning flue gas, in the preparation of drinking water, as a fertilizer additive as well as in building roads, bridges, tunnels and houses.

The raw materials for lime, limestone and dolomite, are found in many places. One notable source is the 370-million-year-old deposits that make up the "limestone belt" of the Rhenish Massif in Germany. German lime producer Rheinkalk operates several plants here; the largest of the group's 14 sites, and also the largest lime works in Europe, is located at Flandersbach, about 25 km south of Essen. At Flandersbach, Rheinkalk burns lime in six shaft kilns and four rotary kilns, after which the product is conveyed to a number of collection hoppers. Such a large number of material streams poses some logistical challenges that must be handled quickly and effectively if production is to remain competitive.

Modernize and simplify

As part of a plan to modernize the burning and refining sections at Flandersbach, Rheinkalk wished to update and optimize lime transport to and from the collection hoppers. The transport system is complex, offering a choice of 254 different routes between the ten kilns and the various hoppers. There are 28 sources and 16 destinations in total, with as many as ten routes in use simultaneously.

The actual product movement is carried out by a large number of different convey-

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ors including belts, worm drives and vibrator chutes, as well as electric and pneumatic distribution flap gates. Before the modernization project, individual route sections were controlled either manually or by two ABB Procontic S+ controllers. The operators used a mosaic switchboard to select individual equipment items and groups of items.

Two different control centers selected the route sections in parallel. This called for coordinated communication, as both control centers were able to select and assign the same route sections. In the event of faults in one route, there was no automatic switchover. A further complication is the fact that the rotary kilns are continuous, whereas the shaft kilns operate batchwise.

The main objectives set by Rheinkalk for the modernization project were to:

- simplify the complicated and time-consuming process of selecting routes;
- replace individual conveyor drives as necessary, without interrupting production;
- improve the quality of the lump lime product by integrating an automatic sampling unit; and
- add belt weighers to recording the quantities of lime added to individual hoppers.

To make life easier for the two operators, it was also necessary to simplify and optimize the procedures by which the collection hoppers are fed. This required the implementation of software to control product routing.

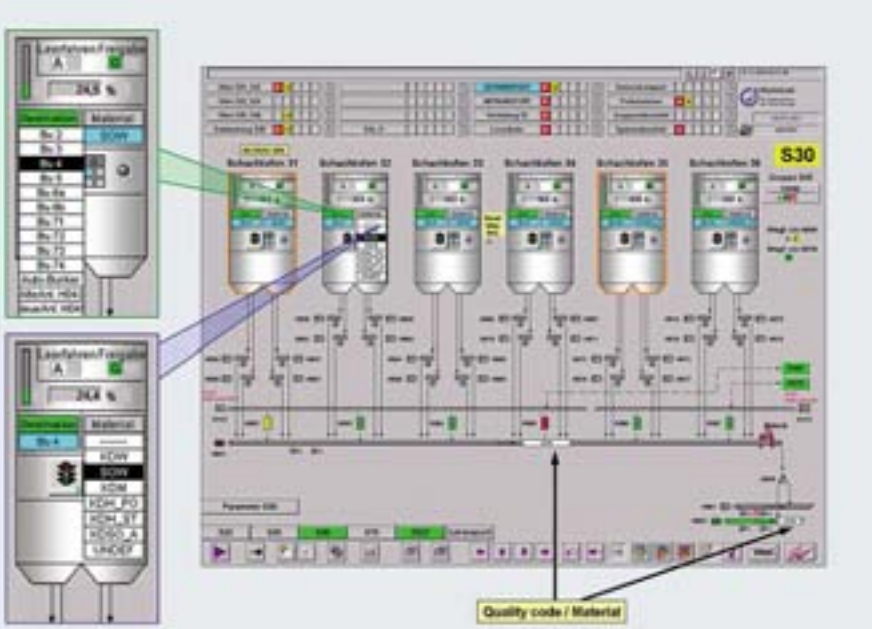
Off-the-shelf solution

One of the specifications laid down by project leader Kristjian Rajic was that the task of assigning routes should no longer be the job of the operator, but should be controlled automatically by means of management software. The project's solution provider, Trips, considered two ways in which to do this. The first option was a customized solution, an approach already used in other parts of the plant. The second was to use standard route-control software with the fewest possible customer-specific changes.

Since the Siemens Simatic PCS 7 process control system was already successfully in use at the Rheinkalk plant, Trips, in its role as a certified PCS 7 Specialist, had already investigated the standard Route Control software package available for this platform, although only for the transport of fluids.

After checking the extensive functionality of Simatic Route Control, Trips decided that this software would be the best choice for route management between the lime kilns and hoppers.

Four important factors in the decision were:



At the kiln, the operator simply selects the destination hopper and the product code from a drop-down menu. The Route Control software then automatically searches for the appropriate route and oversees the transfer of material, taking the product code into consideration.

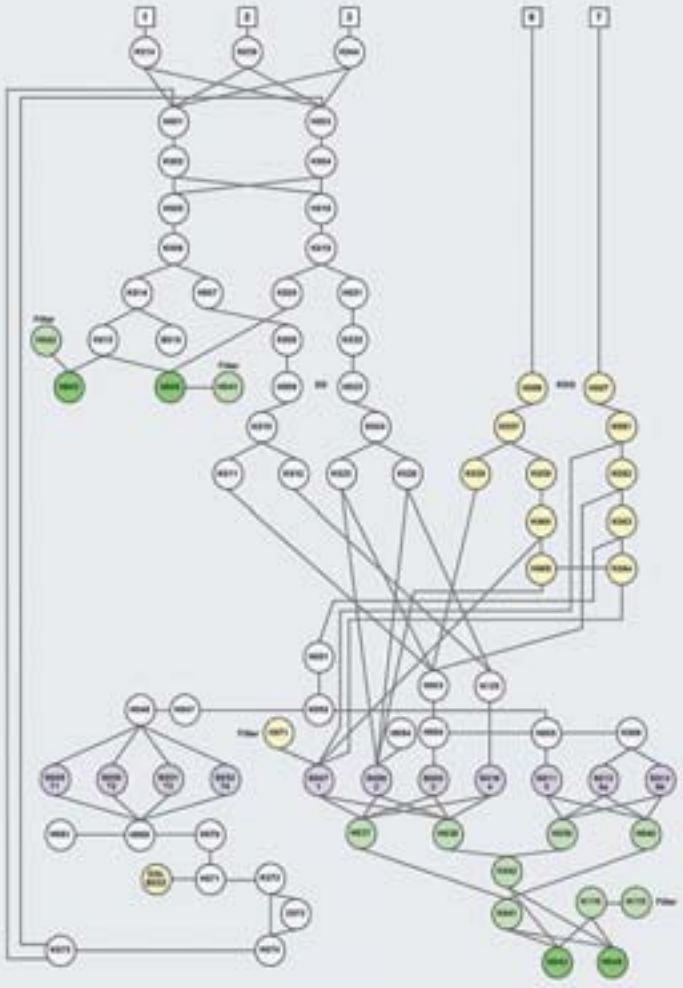
Maximum values for the Simatic Route Control system

Number of Simatic PCS 7 controllers (AS) that can be integrated in an RC project	32
Number of material transports that can be performed simultaneously per RC project	300
Number of partial routes per RC project	64,000
Number of RC elements per partial route	64,000
Number of interconnected RC elements within one transport route	
■ per controller (AS)	450
■ over all PCS 7 controllers involved in the material transport (AS)	No. AS x 450
Route control elements per PCS 7 controller (AS)	
■ Control elements (actuators), e.g. motors, valves, pumps	1,024
■ Sensor elements (sensors), e.g. for scanning flowrates	1,024
■ Parameter elements for setpoint selection, e.g. transport quantities	1,024
■ Connecting elements for saving material data related to the partial route	1,024
Number of mode tables, e.g. cleaning, product transport	64,000
Number of function steps/sequence functions (modes) per mode table, e.g. base position of control elements, open transport valves, open source valve, switch on pump	32
Material definitions and sequential relationships between materials	
■ Material groups	1,024
■ Materials	1,024
■ Materials per material group	1,024
■ Sequential relationships between materials	64,000

- the ability to upgrade as newer versions of the software become available;
- excellent diagnostics during commissioning, helping to ensure quick changeover of individual drives;
- the ability to simulate every routing option would reduce commissioning time;
- and at last the use of pre-tested software modules results in lower engineering costs.

"Although this is standardized software for route control and material transport, the Simatic PCS 7 system is so open and flexible that we were able to implement further specific additions for our customer Rheinkalk, in order to cover every single one of their quite specific requirements," said Christian Trips, CEO and project manager of Trips.

"The Simatic Route Control software helped us to reduce the configuration overhead in this project by about 25 percent," Trips added, "and to trim 20 percent off the normal commissioning time, thanks to



This equipment tree for the lime hoppers, formerly used by the operators to guide their decisions on product routing, shows the complexity of the materials handling system. The Simatic PCS 7 system makes these decisions automatically.

Key figures for the Simatic PCS 7 system at Rheinkalk's Flandersbach works

Number of Simatic PCS 7 controllers	7
Number of I/O signals relevant to route control	1,750
Number of process objects (equivalent to process tags)	11,500
Number of redundant operation station servers	2
Number of operator stations (clients)	8
Number of engineering stations	1
Simatic Route Control	yes
Special features	
■ Use of Cemat industry library	yes
■ Integration of on-site operator panels	1
■ Integration of belt weighers	11
■ Link to laboratory (quality codes)	yes

optimum diagnostics and simulation options."

High productivity, better quality

The task of the Route Control software is to choose product routes and assemble them from individual sections of conveyors and valves. With the new system, an operator now needs to indicate only the source and the destination, and the system does the rest. It checks which routes are feasible, assigns one, and controls the product transfer. If a fault should make one route unavailable, the system chooses another.

Before the modernization project, a new route could not begin to transport product until every section of the route had finished its previous task. This meant that the upstream sections would spend time idling, consuming energy and wasting transport capacity, until the last route section was released.

To optimize routing and raise productivity, the Simatic Route Control software takes into account the time needed for product to travel from one end of each route section to the other. This means that transfers can take place in parallel: upstream sections begin to carry product before the downstream sections have finished the previous job. The result has been a 30 percent increase in the productivity of the conveying system, with knock-on benefits for the entire plant. The new system also stops the buildup of product bottlenecks, which had been a problem with the old regime.

The introduction of automatic sampling has for the first time made it possible to route the lime according to its quality, which in turn allows the site's products to be marketed in a far more flexible way. The Route Control software automatically obtains quality information from the analysis system in the laboratory, and displays this in the form of quality codes representing the quality of the material moving on each route.

The quality code uniquely identifies each batch of lime on its route from kiln to hopper. It allows the Route Control system to send each quality grade to a dedicated hopper, and prevents the accidental mixing of different grades. The constraints that this imposes somewhat reduce the system's freedom to choose alternative routes in the event of a breakdown or blockage, and make it more likely that an operator will have to intervene. The increase in product quality created by avoiding mixed grades makes this worthwhile, however.

"Through the use of standardized route control for automatic transport of materials we were able to significantly reduce the workload for the operators," said Rheinkalk project leader Kristijan Rajic. "They can now concentrate again on their core task of kiln operation. This has resulted in a noticeable improvement in product quality. The foundations have been laid for subsequent projects." ■