



Bits and Bytes from Beckhoff in the Concrete Industry

Electronic Fieldbus Terminals Prove their Worth in Cement Production

Cement manufacture is a world apart. The production process cannot be measured against ordinary standards. High temperatures and heavy shocks occur throughout the process. Nevertheless large numbers of Beckhoff electronic Bus Terminal units are found all over the plant. At the Alsen AG works in Höver, this technology is being used to implement advanced distributed automation.

With a daily production of 3000 tonnes, Alsen AG's cement works at Höver may not be one of the largest production facilities in the group, but it is without a doubt one of those using the most modern automation technology. Höver is one of a number of production facilities in north Germany at which Alsen AG, based in Hamburg, manufacture cement, lime and ready-mixed concrete. But as an industrial concern with a long history, and the largest manufacturer of building materials in north Germany, Alsen are well aware of increasingly fierce competition. Without the introduction of effective automation, the outlook for the continued competitiveness of the home cement manufacturing industry would be poor. The strat-

egy adopted by Alsen AG at the Höver works is one of distributed automation. The initial implementation has involved almost 100 fieldbus terminal boxes in which more than 2000 Beckhoff electronic Bus Terminals pass process signals through Profibus Bus Couplers to the control centre.

Wiring errors are a thing of the past

The technology of electronic fieldbus terminals epitomises here the approach to distributed automation. But this is just the tip of the iceberg. Alsen AG have developed the ambitious plan of introducing this technology stage by stage to do more than replace extensive and costly point-to-point wiring.

Smooth operation of the plant is an additional bonus, since the simplification means that wiring errors – which in the past could only be discovered during commissioning – are almost unknown. Another special feature is represented by short-circuit-proof Bus Terminals, so that a single fault does not bring the entire plant to a standstill. This technology will instead provide the operating staff with specific indications of the faulty sensor or broken wire.

„We just had to do something“, commented plant engineer Matthias Heuer, in support of Alsen management's decision to install new control technology. And in order to profit from the full range of possible improvements, the introduction of a distributed solu-

Using the components of the Bus Terminal, the user can operate an unrestricted mixture of signal combinations for each station.



tion has been linked at the same time to an extensive refurbishment of the control centre. Reduction in the expense of plant wiring was not the only goal in converting to a uniform fieldbus; an improved overview of the situation at the individual units within the concrete works was also part of the plan. There was an additional expectation of increased transparency in the control procedures, a general increase in operating availability and shorter interruptions for maintenance. In short: uniform control technology, planned maintenance, more rapid feedback from the plant and easier plant modification through the use of freely scalable Bus Terminal systems should ensure higher efficiency.

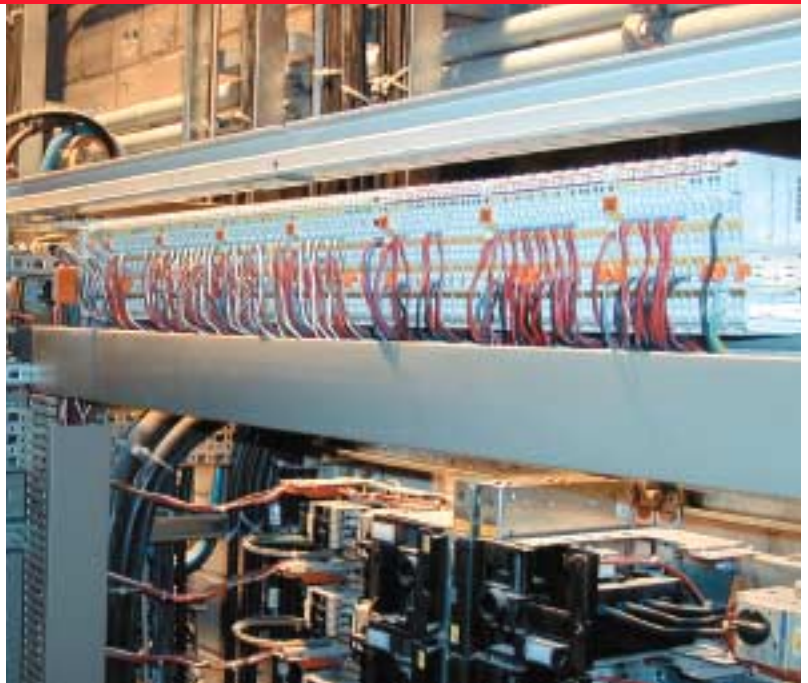
Are electronic fieldbus terminals fit for the rough conditions found in concrete works?

The Swiss parent holding company, Financière Glarus AG, wanted to implement electronic fieldbus technology in Höver - but is the application really that easy, given the unusual special features of the concrete production sector? Evidence of feasibility came in 1996 from the first pilot application in the packing area – the Beckhoff Lightbus was used at that time. „What really impressed us was the way we could integrate the new system into the old point-to-point plant wiring, and have so few problems“, recalls Heuer of those beginnings back in 1996. Converting to the other fieldbus was as straightforward as could have been hoped. It was only necessary to exchange the Bus Couplers.

A Portrait of Alsen

Alsen AG is a richly traditional German industrial concern, and are north Germany's biggest manufacturer of building materials, with headquarters in Hamburg. The core business includes the production of cement and lime – from their own raw materials – in the Lägerdorf and Höver factories, and the manufacture of ready-mixed concrete. The group is also active in the pre-cast concrete products sector, and in the supply of building materials and aggregates. Alsen AG was formed in 1997 when Alsen-Breitenburg Zement- und Kalkwerke GmbH, of Hamburg, merged with Nordzement AG, of Hanover. The majority shareholder is Financière Glarus AG, of Switzerland. With a turnover of more than 12 billion Swiss Francs, they are the world's largest supplier of building materials such as cement, aggregates, ready-mixed concrete and concrete additives. They also provide services, and have interests in more than 60 countries in every continent.

The distributed plant structure and the modern approach to distributed control by means of electronic terminals allows the operator to automate his plant in separate steps taken at different times.



This was what gave the designers a demonstration of the feasibility of converting the entire plant step by step. The team of engineers divided the cement production plant into eight different segments. This made it possible to convert these, either singly or in groups, to the new distributed control technology in the context of the annual overhauls. Proceeding in this way made it possible to perform the conversion within the individual production areas whilst still ensuring continued operation.

The intention from the beginning at the Höver works was that the distributed approach would reduce the need to invest in extensive and expensive contactor supports, control cabinets, cable routes and installations, while at the same time lowering the expense of the conversion itself. For this reason the plant engineers have installed individual stations with Beckhoff Bus Terminals for distributed input/output in five of the eight production segments over the last four years. In these standard terminal boxes a maximum of 64 Bus Terminals link the sensors and actuators over Profibus to the processing modules in the control centre.

Further implementation of the automation scheme brings a number of requirements into focus at once. First of all, it should be possible to convert the individual production segments flexibly to the new technology. The second important condition placed on the automation scheme is based on the need to avoid interfering with the overall production flow while converting the

individual stations. At the very least it was required that the „old“ and „new“ control technologies should be able to coexist during a transitional period.

Conversion can only take place during the annual operating break

A further crucial condition was presented by the fieldbus technology itself, which in this case was Profibus. „Because of our relatively modest real-time requirements we specified 1.5 Mbaud as the data transmission rate. This meant that we could omit expensive screening when laying the Profibus cable“, explained Matthias Heuer. „Changing to higher speeds such as 12 Mbaud immediately brings additional EMC problems and significantly shorter cable lengths“, says the control expert.

However standardised fieldbus technology also meant that the inputs and outputs of the section of the plant that was to be replaced could be installed and tested in the run-up to the conversion itself. The advantage of this is that the commissioning can be simulated conveniently, since it largely takes place at the computer. During the four weeks of the operating break it is „only“ then necessary for the old cabling and its contactor supports to be removed and the drives to be reconnected. This reduces the expense involved in the subsequent final testing to a minimum.

The Alsen team went about this automation task as follows: the pro-

cessing groups, in co-operation with the higher-level ABB control system, coordinate the individual areas and ensure that production proceeds continuously. The communication functions in the processing modules, each of which has two Profibus connections, carry out the exchange of data with the signal pickups in the field. Each individual automation component in the segments, whether already implemented or still planned, is linked in a tree-like structure to the processing modules via Profibus. This ensures, on the one hand, that the machine and production data from the distributed sensors and actuators, needed for continuous cement manufacture, can be directly exchanged and processed within very short reaction times. At the same time it is possible in this way for the prescribed set values, rotary speed ranges and diagnostic information for the drives to be passed to the central unit and co-ordinated with the machine-related sequential control.

More than 2000 Bus Terminals at 82 nodes collect the process signals

82 nodes contribute significantly to continued decentralisation at the Alsen works. A significant part is played here by the 2 and 4 channel Bus Terminal range from Beckhoff and its fine modularity. Matthias Heuer had this to say: „We soon recognised that, in contrast to the individual Beckhoff terminals, the 8, 16 and 32 channel modules from competitors are too rigid and take up too much room.“ It is exactly this fine

In Alsen AG's cement works at Hanover, more than 2000 Bus Terminals pass signals rapidly and securely over Profibus.

„patchwork“ that reduces the space requirement in the non-central terminal boxes at Alsen. The Bus Terminals have another advantage: „We wanted to have just one terminal in each of the plant's control loops, so that only the sensor would be connected to the fieldbus terminal, and then pass the signal over Profibus straight to the controller,“ explained Heuer, who is an expert in this kind of automation. That lowers the costs and reduces the chance of a fault. In comparison with the past, where faults were only discovered during commissioning, wiring errors are now almost unknown. The Bus Terminals can be stacked like standard series terminals, and are connected to the internal system bus and the power supply, including the protective earth, as soon as they are plugged in. The link between the Bus Terminal and the fieldbus is the Bus Coupler, and these are available for all common fieldbus systems.

A broken cable does not bring the entire plant to a halt

The Bus Terminals deserve particular attention, due to the way they integrate various measurement and control products into a consistent system. At the Alsen works the mix of signals consists not only of purely binary signals (with and without electrical isolation) but also of interfaces using 4–20 mA, 0–10 V or PT100 type signals that need connection. At the Höver works, for example, PT100 and thermocouple Bus Terminals are involved in measurement of the temperature inside the bearings of the huge revolving kiln, in order to regulate the cooling circuit.



The Process

Boulders are blasted out at the nearby quarry, and are broken down in mobile crushers to such a size that they can be transported on conveyor belts. The stone is carried over a total of several kilometres of belt to the raw material storage hall. From there it is passed up to the grinding tower, where it is reduced to a fine powder. This dust is then stored in the mixing silo. From there it is passed, together with additive materials, from above through the heat exchanger tower and into the huge revolving kiln, which is tilted slightly from the horizontal. The basic material for cement is created in this kiln in the form of fist-sized clinker pieces. Large fans then draw the hot air through the oven and the heat exchanger tower, up through the filters and then into the exhaust chimney. The process heat is needed in order to activate the grinding process. The clinker then falls out of the oven, and is ground to make cement. All the instrumentation signals in the plant, originating, for instance, in the rotary drives for the oven, or from the solenoid valves in the blowing equipment, and including a huge number of measurements of pressure and temperature, are passed from more than 2000 electronic fieldbus terminals to the control centre through the Profibus Bus Couplers located in dirt-proof terminal boxes at a total of 82 locations.

Beckhoff offer a particularly extensive range of Bus Terminals, consisting of more than 80 different terminal blocks with integrated electronics and permitting an independent mix of control and fieldbus.



Another step forward in convenience and safety is represented at Alsen AG by the use of digital input terminals having short-circuit-proof sensor power supplies, and limiting the short-circuit current to 500 mA. The advantage of this is that if a short-circuit does occur, the main fuse does not blow and cause all signals to fail. Rather, the fault in the particular cable branch is detected. The status of the terminal is then passed to the controller in the control room via the Bus Coupler, so that the operator can move rapidly to rectify the fault.

The Alsen team were impressed repeatedly by the variety of signal types on offer: „For every task we could find just the right Bus Terminal“. This applied also to the old analog pressure transducer that remained in the plant: there was no difficulty integrating it through the appropriate analog terminal into the modern plant system. Matthias Heuer is enthusiastic: „Although so far we have only refurbished five of the total of eight production sectors, we are already using more than 2000 Bus Terminals. What’s really helpful is the clear overview and the ease with which we can deal with changes or faults, because the Bus Terminal gives us ideal transparency and flexibility.“

The automation scheme being installed at the Alsen works is completed by diagnostic routines and easy commissioning. For Matthias Heuer it was the simplicity and variability of the bus terminals from Beckhoff that tipped the balance in favour of implementing an open, distributed automation design.

Beckhoff: Profibus capability

The Beckhoff range of Bus Couplers for Profibus includes seven different versions with which the plant erector can implement almost any Profibus application: in particular, these include Profibus FMS and DP Bus Couplers in 1.5 Mbaud and 12 Mbaud versions, Profibus DP couplers with fibre optic connections and a low-cost version of the Profibus DP couplers for purely digital inputs and outputs. The Profibus BC3100 Bus Terminal Controller contains a mini-PLC, programmable in accordance with IEC 61131-3, for distributed signal processing. All the couplers are capable accepting a total of 64 Bus Terminals. The Profibus system family is completed by the robust Fieldbus Box modules, made to protection class IP 67. The Profibus fieldbus cards in PCI technology, if combined with the TwinCAT software PLC/NC, enable a complete Profibus control system to be constructed.