



Process control in synthetic resin production

Experience with the Remote I/O System IS1 manufactured by R.STAHL

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Figure 1: Production line for synthetic resins

The company SYNTHOPOL CHEMIE is a mid-sized family run company founded in 1957 by Dr. Peter Koch in Hamburg, which specializes in the development and manufacturing of synthetic resins for the lacquer, paint, plastic and adhesive industries. Due to rapid growth and the resulting need for additional capacity, the business will soon be moving to Buxtehude from its current location in view of the port in Hamburg.

Along with standard binding agents, the product range includes numerous innovative products. Today SYNTHOPOL CHEMIE is a leading manufacturer of synthetic resins with a production volume of 65,000 t per year (Figure 1).

Start of automation

The first steps towards automation at SYNTHOPOL CHEMIE were taken in the early seventies. Initially only a scale as a central element for the various production lines was equipped. However, even here there were signals into and out of the hazardous area, so safety was an issue. The first production lines were then automated in the eighties. In this case, it was not just input/output signals that were processed, but also temperature measurements, such as PT100 and standard 4-20 mA output and standard 4-20 mA input signals. The distribution racks with PLC and signal isolation were located in the safe area in the control rooms. The individual signals to the field devices were routed as intrinsically safe circuits in the hazardous area Zone 1, via isolators on 19" boards (Figure 2). The ICS 1000 system manufactured by R.STAHL was used as the isolation system in the 19" rack. Until the end of the nineties approx 8 production lines were automated in this way to ensure reliable, high availability production. Due to the continuously increasing network of production lines, there were often complex interfaces between the individual production line control systems so that it became necessary to re-design the process control system.

IT-based central process control system

After a major fire in 2000, not just the building and production lines were re-fitted and modernised, but the opportunity was taken to replace the individual production line control systems with IT-based process controls using a central control system. This was necessary because of the networking of the production lines for facilitation of fully automatic operations incl. a batch system. The task was to find a robust, powerful and high availability standard design. The decision was made for the PCS7 control system with flexible batch control manufactured by Siemens, and interfacing to the field using the Remote I/O System IS1 manufactured by R.STAHL. The communication with the related interface module in the PCS7 control system has since then been via Profibus DP using optical fibre technology.

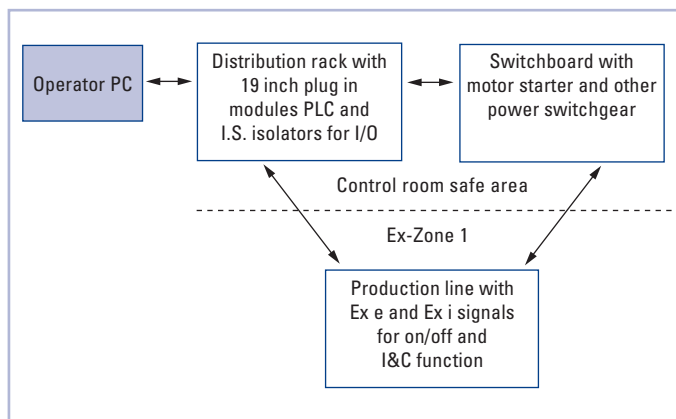


Figure 2: Automation concept up to 2000 with individual I.S. isolators

Remote I/O System IS1

In the early nineties, signals transmitted to process plants and intrinsically safe circuits into and out of explosion hazardous areas were isolated using safety barriers or electrical isolators that were installed in control rooms within the safe area. With rapidly progressing digitalization and the related increase in the number of signals, partially caused by the increased networking of the plants, bus solutions were developed for process technology. In order to optimally utilize this method of communication, the Remote I/O System IS1 for integrating field signals from parts of the installation in hazardous areas as within these bus structures was placed on the market by R.STAHL.

The Remote I/O System IS1 essentially comprises 3 components, the bus rail, the central assembly CPM & power module, and the individual I/O modules for connecting the field signals. The selection and combination of the system components is very easy and can even be undertaken for control room design (Zone 2 version) by personnel without special training or extensive system knowledge.

The bus rail is mounted on a 35 mm DIN rail NS35/15. Retaining clips on the bus rail and end pieces ensure secure seating that is even allowed to for use off-shore.

The central assembly contains the power module for the supply of the I/O modules connected including the field devices connected to the modules, e.g. transmitters, positioners and solenoid valves, and the CPU for communication with the connected automation system and I/O modules.

Based on the optimal application of different types of protection, ›intrinsically safe«, ›flameproof enclosures«, ›increased safety« and ›encapsulation«, a compact and robust design is achieved. Additionally, based on the modular layout the configuration can easily be adapted to the related installation requirements.

For the installation of remote I/O technology in hazardous areas, this equipment must comply with the requirements of the ATEX directive 94/9/EC for the equipment category 2/ Zone 1, and equipment category 3/Zone 2. For usage in Zone 1 an EC type examination certificate must also be available. R.STAHL supplies the Remote I/O System IS1 as a complete ready-to-connect field station incl. all the necessary modules and the related documentation.

The extensive experience of R.STAHL with recognized types of protection has made it possible to implement solutions for the connection of 4-wire transmitters in Ex e or Ex i technology, e.g. for the connection of Ex d, Ex e and Ex m solenoid valves as well as for special installation of back up fuses for these valves.

The usage of HART communication is a further option with this system, both for Profibus, as well as, for Modbus. Of course, with the Remote I/O System IS 1 it is also possible to provide cable or equipment redundancy for installations requiring increased availability.

From the start of the IS1 system development, consideration was given to the need for ensuring cost-effective usage of this system in areas of Zone 1, Zone 2, and in the safe area, as well as, combinations of these areas. →

Production line control using bus ring and remote I/O field stations

The Remote I/O System IS1 makes it possible to use the same I/O technology both in the safe area and in the hazardous area. While in the first production lines at SYNTHOPOL CHEMIE the remote I/O stations were installed in the control room outside the hazardous area, on the other production lines the remote I/O technology was installed in the field within the hazardous area due to lack of space in the control room (Figure 3).

The signals at the remote I/O field stations include intrinsically safe PT100 measured values and analogue signals, as well as, non-intrinsically safe signals that are routed via connection technology in the type of protection increased safety »e«. As all necessary components from the redundant CPU, through the Ex-e modules, to the fuse protection and termination technology are housed in one enclosure in type of protection increased safety, a type examination and the related certificate including the necessary verification of the intrinsic safety of the field circuits connected are available for the entire assembly. This aspect, in particular, is crucial for successful implementation.

The signals are sent from where they are produced to a Profibus DP converter and from there routed to the safe area via a bus cable.

Consideration of the probabilities of failure found that the failure most likely to occur is a bus cable fault, e.g. during modification to the production line. To achieve redundancy here the bus was laid as a closed cable ring. Due to their low probability of failure, redundant CPUs were not installed. A larger production line comprises 6 remote I/O field stations divided over three floors. Due to the distribution of the signals from one production line over these 6 field stations, the failure of one CPU there will not mean total I/O signal failure. Should one of the field stations have a malfunction, the remaining stations continue to function due to the bus ring structure. Currently 25 field stations are installed in Zone 1 in various production lines. Since initial commissioning there has not been a failure. For this reason there is no redundancy in the production line control except for the server and network architecture.

Commissioning, diagnostics and device replacement

Due to the exactly defined interface between IS1 and the PCS7 V6.1, after wiring, the field devices are placed in operation directly using the PCS7 via the wiring to the related IS1 module and the bus interface to the S7. It is necessary to install a suitable IS1 driver for the selected control system. Installation and integration are undertaken by first defining the Profibus-DP structure in the hardware configuration in the PCS7. Then the bus addresses are set on the field stations and as a result, communication with the field devices is made possible. By defining the related position of the modules in the DP structure, the individual I/O modules can be integrated into the programming using their related addresses. The modules are integrated with protection against wire break.

Should a channel, a module or a complete string suffer a mal-

function during operation, the malfunction can be localized using the control system based on the address displayed for the section, module or channel. At the lowest level is also possible to perform diagnostics for a wire break or a short circuit in a single channel.

In the case of an entire module suffering a malfunction, an error message is output to the process control system by the CPU pertaining to the related section in plain text incl. module type. Depending on the configuration of the control system, various »levels of error message« and related texts can be implemented. On site the malfunction can be quickly located by a flashing red LED on the related module. To ensure malfunction-free operation as quickly as possible, the module can be replaced in operation. During this process it is not necessary to set any parameters or undertake any configuration work prior to the replacement. It is, of course, only possible to make replacements with absolutely identical module types.

Conclusion

Experience till now has shown that the IS1 system manufactured by R.STAHL impresses particularly due to its high availability and resilience to failure. Due to its compact and modular design, its simple commissioning, and its complete approval for the use in potentially explosive atmospheres this system offers a particularly advantageous, technical, cost-effective solution.

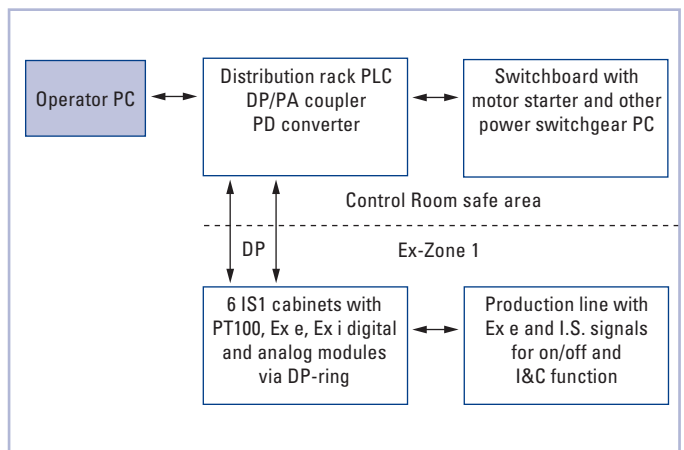


Figure 3: Automation concept with Profibus DP ring and Remote I/O System IS1