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## Unbeatable for Fieldbus Migration Solutions

### Rhein Chemie benefits by opting for Remote I/O

**The modernization of older chemical industry plants that do not utilize fieldbus technology is always a current issue. A completely new build is out of the question for economic reasons, but the huge advantages of today's control and fieldbus technology must not be wasted. It is exactly this situation where Remote I/O technology provides an unbeatably efficient solution. Rhein Chemie in Mannheim recognized this early on. A solution was developed and implemented successfully.**

Rhein Chemie is a global company in the chemical industry that has been successfully providing tailor-made additives and service products for more than a century. Some 850 employees develop, produce and sell additives and innovative service concepts for the rubber, lubricant and plastics industry worldwide. Additives are used, for example, in the manufacture of tires, sealing profiles, dashboards, industrial lubricants, engine mounts, radiator hoses and seats that provide the desired properties to the end products while also ensuring cost-efficient production. The solutions are individually tailored to customer requirements. The company has its headquarters in Mannheim with subsidiaries and production facilities in Europe and Asia as well as North and South America. Rhein Chemie is a 100% owned subsidiary of LANXESS, based in Leverkusen, Germany.

The numerous plants where the batches are produced are small and consist of stainless steel and enamel reactors, pastillation belts, absorbers, vacuum driers, mixing and filing systems. Various tank farms, a waste gas cleaning system in accordance with the German *TA Luft* air pollution control regulations (primarily for H<sub>2</sub>S removal) and other secondary installations as well as a high-capacity analysis laboratory complement the production facilities.

## Modernization of the multi-purpose plant

The multi-purpose plant was established in 1974 and converted from pneumatic to electric in 1992. It plays a key role in the manufacture of products for the lubrication industry in Mannheim. It comprises nine plants for the manufacture of various products. The majority of these plants consist of a central stirring reactor (fig. 1) with a volume of 6-12 m<sup>3</sup> and various peripheral field devices. In the reactors, the products are produced in batches from the supplied liquid and solid raw materials with a retention time of approximately 24 hours and at temperatures of 10°-200°C. The plant surroundings are classified as hazardous area Zone 2, the reactor manhole Zone 1 and the reactor Zone 0. The areas around the reactors are monitored by gas detectors. Quality assurance is carried out via laboratory analyses with entry of the analysis values into the company's SAP system.

*Fig. 1*

When the plants were converted in 1992, they used a great deal of wiring and space using 4-20 mA/HART field devices (for temperature, pressure, fill level, mass flow rate, viscosity etc.) with point-to-point connections to a PLC and from there to a Process Control System (fig. 2, right). In 2004, after 12 years of operation, a new Process Control System was installed (Freelance 2000, ABB) with PROFIBUS fieldbus technology. A decision needed to be made regarding the way how to connect the field devices to the process control system.

The alternatives were:

- Connection via Remote I/O technology (RIO) while retaining the available equipment and the existing field cabling. Advantages were space and cost-saving installation between the RIO and Process Control System and the possibility of central access to the field devices.
- A new installation connecting (new) PROFIBUS PA field devices directly to PROFIBUS with improvements in topology, bus power supply, interchangeability of the devices, comprehensive diagnosis, etc.

Rhein Chemie opted for the solution with Remote I/O, following the principle “don't necessarily abandon the tried and tested, but do take full advantage of new opportunities,” said Stefan Klein, the responsible plant engineer. He continued: “In RIO technology, we saw the ideal way to cost-effectively modernize our many plants without changes in the field, while incorporating the significant advantages of modern fieldbus technology and allowing room for further expansion.”

## The Rhein Chemie solution

*Fig. 2*

The right part of Figure 2 shows the previous plant topology with point-to-point connections of field devices to the controller and forwarding to the Process Control System. The new concept is shown on the left side of Figure 2 and in Figure 3. All parts of the multi-purpose plant have now been converted. The field devices are connected via point-to-point technology to the Remote I/Os using RPI, **R**emote **P**rocess **I**nterface from Pepperl+Fuchs and installed in the control cabinet. Several RPIs are located in each switch cabinet, in accordance with the number of inputs and outputs. Signal transmission from the RPI takes place via PROFIBUS DP – in a combination of wire and fiber-optic cables with corresponding converters – to the switch room and from there to the allocated Freelance Controller (Figure 3). The fiber optic cable transmission path between the field and switch room is either in a loop (Figure 2, left) or a star (Figure 2, center) configuration.

All switch cabinets in the multi-purpose plant (currently 27; the final installation will contain approx. 40) have an identical design, which greatly simplifies elements such as TÜV approval, maintenance or copying documentation and software. The same applies to the construction and checking of the cabinets. The control cabinets are produced by the Pepperl+Fuchs plant in Bühl/Germany.

The device settings are modified on site using a handheld. Centralized parameterization and configuration of RPI Systems and HART devices at the plant with FDT and PACTware is technologically possible, but currently only envisioned for the future.

*Fig. 3*

### Remote Process Interface (RPI)

The user has identified a clear requirement profile for modern Remote I/O device technology.

The following are required:

- A good modular design with a wide selection of function modules
- Galvanic isolation between fieldbus, field circuits and power supply
- Easy replacement of modules during operation
- Communications option for parameterization and configuration
- Monitoring options
- Suitable for HART functionality

Numerous manufacturers have addressed these requirements and offer associated products. For the plants under consideration, Rhein Chemie opted for the RPI system from Pepperl+Fuchs, a noted specialist in interface technology.

The RPI system has a modular design and consists of a mounting rail, Power Rail, supply module, Gateway (Com Unit) and single or multichannel I/O modules. Power is supplied to the RPI system by simply snapping modules onto the mounting rail with the Power Rail insert. The Power Rail simultaneously forms a redundant Backplane bus that ensures communication of the I/O Modules with the Gateway. Extensive Motherboards and separate power supplies are no longer required. The sensors and actuators in the field are connected to the I/O modules of the RPI. The measuring signals are transmitted serially to the Process Control System via the Gateway and just one fieldbus cable. RPI has extremely high availability, since the power supply of the system modules, the Gateways and the external bus can be redundant. The internal Backplane bus is always redundant as standard. The I/O status of the field devices connected to the RPI can be viewed via an LCD display at the RPI Gateway, for diagnostic purposes.

*Fig. 4*

Figures 3 (left) and 4 show the control cabinet with the RPI system at Rhein Chemie.

### **Advantages for the operator**

Operators benefit from the "center position" of RIO technology between conventional technology and fieldbus. They can use the features of both 4-20 mA technology as well as fieldbus technology, such as:

- unchanged field installation of devices and their point-to-point connections to the Remote I/O,
- continued use of economical 4-20 mA devices,
- continued use of available knowledge and experience in commissioning, maintenance and servicing,
- live exchange of components during operation (hot swapping)
- economical and space-saving wiring from the Remote I/O to control room
- central access to all devices, e.g., from a maintenance system
- subsequent upgrades (comprehensive diagnoses, central operation, introduction of PROFIBUS PA devices)

The positive experiences of Rhein Chemie are faster and easier maintenance, the possibility of online extensions and on-site modifications without downtime, as well as the availability of plant information. The LCD of the RPI delivers diagnostic information regarding the switch

state of the binary signals, the analog measured values and the credibility of the control values. This is a great help for maintenance personnel and makes troubleshooting much easier. An explosion-protected laptop with operating software for local diagnostics, required in many other systems, is not necessary.

## Summary

Remote I/O technology has repeatedly proven itself to be an ideal solution for upgrading an existing efficient chemical plant in terms of process technology, without essential modifications to the field instrumentation, with a modern Process Control System including fieldbus technology. The project at the Rhein Chemie multi-purpose plant using the RPI system is proof.

### Remote I/O at a glance

Remote I/O (RIO) are interface connections, from the field to the controller, that allow the connection of traditional, 4-20 mA input and output signals onto a bus network and simplify wiring. RIOs are bus nodes of a fieldbus system with all available functionality. However, technologically, there is a huge difference from the fieldbus: The field signals are not transmitted with totally digital signals, but split: there is analog transmission from the field device to the RIO, then there is digitalization, and finally transmission of the digital values to the Process Control System.

Remote I/O systems can be mounted in a safe area in a control cabinet or on-site in the field in a switch cabinet. For chemical applications, this is often equated to Zones 1 or 2 of hazardous areas. The signal circuits of RIOs are then primarily executed in the explosion protection method intrinsic safety (Ex i) and are completely "suitable for hazardous areas use".

**Key words:** Rhein Chemie, Pepperl+Fuchs, Remote I/O, RIO, RPI, safe area, intrinsic safety, Zone 1, Zone 2, migration, modernization, HART, PROFIBUS, fieldbus, field cabling, fiber optic cables, diagnosis, field wiring, field instrumentation.

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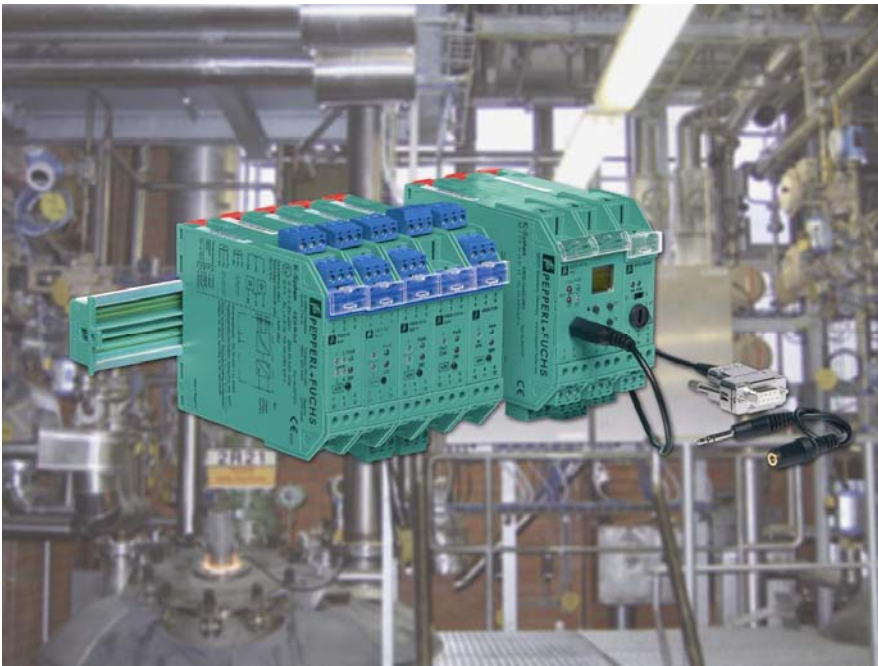
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Eye-catcher



Fig. 1: Part of the plant with associated RPI switch cabinet

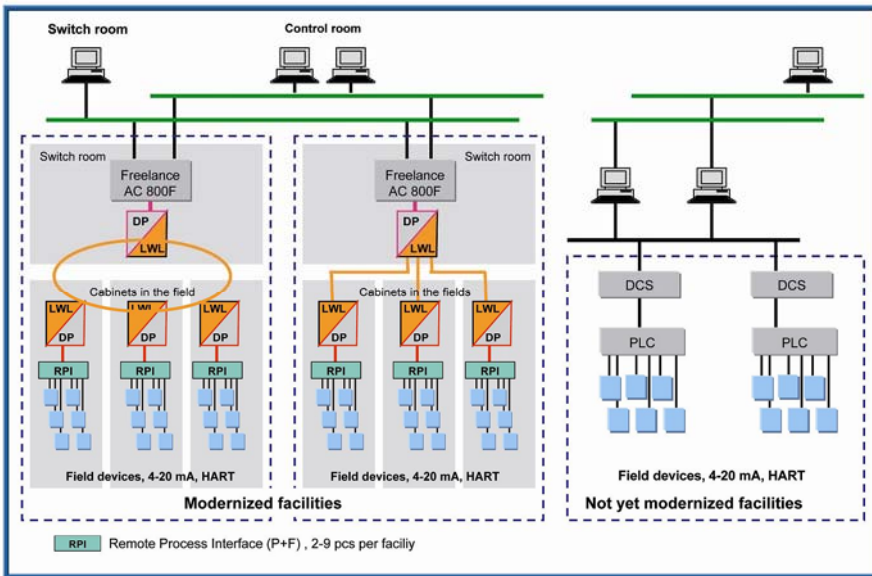
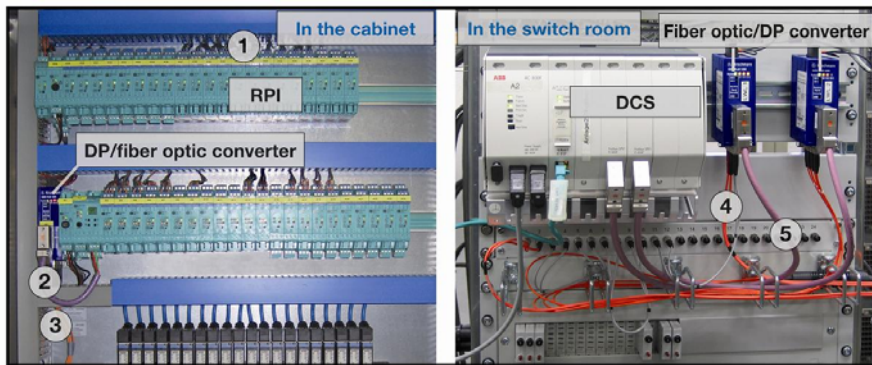
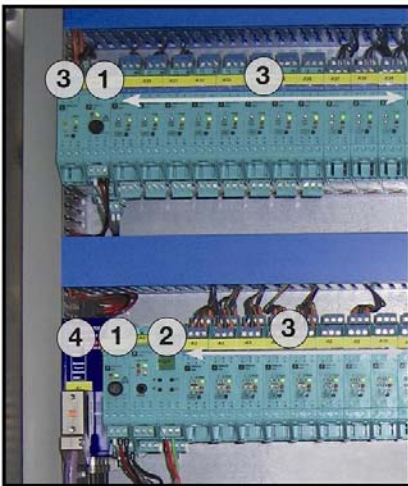


Fig. 2: Plant Topology after modernization and before modernization



- 1 Connections between RPI and field devices
- 2 ROFIBUS DP between RPI and DP/fiber optic converter
- 3 Output from DP/fiber optic converter to the switching room
- 4 Input into the fiber optic/DP converter from the switching room
- 5 Output from the fiber optic/DP converter to the DCS

Fig. 3: Switch cabinet (left) and associated components in the control room (right)



- 1 Power feed module
- 2 Profibus DP bus coupler
- 3 I/O modules
- 4 DP/fiber optic converter

Fig. 4: Components of the RPI-system