

Fully automated milk  
laboratory with high  
sample throughput



→ The Dutch milk testing laboratory MCS Nederland provides an example for a complex networked testing topology. The fully automatic control is based on automation components from Beckhoff. The project was realized by Raudszus Electronic GmbH, a system provider for milk logistics, and b-plus GmbH, specialists for the automation of testing stations.

## Innovative solution with transponder, Industrial PC and automation software

Milk is milk, one might think, until one has paid a visit to the Dutch milk testing laboratory MCS Nederland at Zutphen. In this highly automated laboratory, at full capacity up to 15,000 milk samples from Dutch milk suppliers are analyzed and examined every day for components such as fat, proteins, germs or antibiotics. The company b-plus GmbH has implemented the control system for the complete routing and identification process using automation components from Beckhoff, in order to avoid confusing the samples and to keep together what belongs together.

The differences in milk quality have a number of reasons, including crucial factors such as the age and nutrition of the cow, the method of keeping and the health of the animal, and any administration of drugs. The price of the milk supplied depends on the established quality and quantity.

In the past, bar code labels that were manually attached to the sample bottles were used to link the milk samples to the suppliers. A DOS computer and a bar code scanner were the only equipment available for determining performance-related payment of the suppliers in the test laboratory, based on quantity and quality. Given the large quantity of milk samples that pass through the laboratory every day, this was a complex procedure. b-plus project manager Harald Bügel explains the current procedure: "Today, a sample is taken in a plastic bottle when



Sample bottle with RFID tag



## More than 40 Beckhoff controllers in action

The hardware of the milk analysis plant consists of a total of eleven stations that are consistently based on Beckhoff controllers, ranging from Industrial PCs to Bus Terminal controllers:

- | 5 x Industrial PC C6320 for the pipetting device,
- | 11 x Embedded PC CX1000 inclusive 11 x Control Panel 6.5 inch CP7819 for the basic unit,
- | 7 x CX1000 for the warm bath,
- | 4 x CX1000 for the cold buffer,
- | 2 x CX1000 for the repeater,
- | 1 x CX1000 for the bar code/tag converter,
- | 1 x CX1000 for the cold/warm decider,
- | 2 x CX1000 for the mixing units,
- | 7 x BC9000 Bus Terminal controller for the decision unit,
- | 2 x BC9000 for the check unit.



Overview of thermal area

the milk is pumped into the tank truck, and the supplier data are written to transponders installed in the base of the bottle". These so-called RFID tags have unique ID numbers for identifying the samples during the subsequent testing steps.

### XML data transport via TCP/IP

"The procedure becomes exciting from a technological point of view when the milk samples arrive in baskets, each containing 4 x 12 bottles, are placed on a conveyor by a robot and fed to a transponder reader. Here too, Beckhoff components are used," said Harald Bügel. The CX1000 Embedded PC transfers the tag reader data to the host computer via an ADS command. Here, the TwinCAT automation software converts them into an XML data telegram, which is sent to the evaluation database via TCP/IP. "We use Ethernet as the bus system," explains Bernd Eggl from b-plus. "Beckhoff offers suitable Bus Couplers, based on which b-plus realized an appropriate XML gateway."

The subsequent route of the sample is specified in the evaluation database. A sample plan has to be established to decide which analyses are to be carried out. A CX1000 with TwinCAT CE ensures that the routing data "reach the sample", and that the appropriate cylinder gripper transfers the bottle to the right conveyor



belt. Two "mixing units", one each for cold or warm tests, communicate data between the respective conveyor buffers and the laboratory buffers. When requested by the analytical equipment, they assemble so-called batches consisting of 46 samples and 2 standards, mix the milk and distribute it, but obviously not without saving the destination information for the bottles in the transponders. The samples then take different routes through the laboratory, depending on whether they are destined for cold or warm analysis. In the cold area, where the

milk is not heated for the analysis, four analysis stations determine the number of bacteria contained in the milk at a temperature of 4°C. An analysis station consists of four components: the cold buffer, a wall feed-through, the basic unit and the analytical equipment. The warm area is bigger: It consists of a total of seven analysis stations, four Milcoscan, two cell number and a purity analyzer. The CX1000-controlled warm bath ensures a constant sample temperature of 40° C. It has room for four batches, i.e. 192 bottles. The warm bath also receives its bottles from the mixing unit via a conveyor belt. The four Milcoscan stations that examine the milk for fat, protein, lactose and other components communicate via Ethernet with the PC-controlled pipetting devices, which pipette the milk onto micro titer plates, where they are examined for antibiotics. A compact control cabinet PC in miniature format is used as the control platform.

### All basic units are equipped with CX1000

Irrespective of whether the cold or warm testing procedure is used, the core components of all analysis stations are the CX1000-controlled basic units. They are used to orientate, shake and open the bottles. The sample data are transferred to the analytical equipment via an RS232 interface. Subsequently, the samples are closed, returned to the lower area via an elevator and a return chain, and removed. "The operator can intervene in the process at any time via the 6.5-inch Control Panel from Beckhoff," said Harald Bügel. The visualization program developed by the b-plus specialists is based on C++.

"Since the complete automation is based on Beckhoff components," said Mr. Bügel, "we were able to guarantee our customers continuity during programming, operation and commissioning."

The last sample station in both test methods is the repeater, where the existence of a valid analysis result is ascertained via a database query. If this is the case, the bottle is removed from the laboratory area, emptied and recycled. If there is no valid result, the sample is returned to one of the large buffers, from where its journey through the laboratory is repeated.

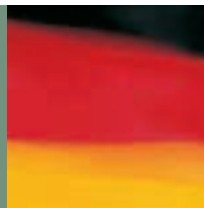


## b-plus GmbH

The company b-plus GmbH, based in Germany, is an innovative system provider that specializes in test system automation, automotive applications, embedded systems and mobile computing, offering state of the art technology. Based on long-standing experience with project and product applications, for example in industrial networking or the design of complex control software, the company realizes sound solutions for a wide range of tasks. b-plus is a complete service provider offering consulting service, project design, project management, or complete project realization.

> [www.b-plus.com](http://www.b-plus.com)

Analytical equipment with basic unit. The equipment is operated via a 6.5" Control Panel from Beckhoff.



## Raudszus Electronic GmbH

The company Raudszus Electronic GmbH, based in Germany, is a system provider for data logistics specializing in milk transport operations from suppliers to dairies. Based on decades of experience within this sector, the company is a pioneer and market leader in the application of state of the art data acquisition and processing techniques. Technologies such as GPS supplier identification, data transfer via GPRS and Internet, and route planning and optimization have been developed over the years and are today used in many milk collection vehicles throughout Europe.

