FOUNDATION Fieldbus Application at Tangshan Iron & Steel

Microcyber Inc. is dedicated to fieldbus and industrial Ethernet technology promotion and application. The company previously implemented a FOUNDATION fieldbus-based Distributed Control System (DCS) at the Tianjin Conducted Coking coal plant using fieldbus H1 (31.25 kbit/s) technology. This application opened up new opportunities for upgrading the plant's traditional control system to the latest process automation technology.

In August 2006, Microcyber took the lead on a control system modernization project for a coking plant at Tangshan Iron & Steel. This project used advanced FOUNDATION fieldbus technology, including High Speed Ethernet (HSE). By leveraging various properties of Tangshan's original control system, while migrating to the latest fieldbus solution, Microcyber's solution improved control at both the enterprise and management levels.

Process Description

The coking plant's original automation platform consisted primarily of outdated analog instruments. As such, the control quality of the entire system was very poor. With the advent of sophisticated production techniques, the original controls were unable to meet Tangshan's process requirements—thus necessitating the upgrade to a fieldbus automation architecture.

The Tangshan Iron & Steel coking operation is divided into two sections: a crude benzene section and a refined benzene section. The crude benzene section consists of 42 analog inputs, and the refined benzene section consists of 36 analog inputs and six analog outputs.

Fieldbus Control Solution

Based on an analysis of Tangshan's original control system configuration, and its plant's process automation requirements, Microcyber designed the new FOUNDATION fieldbus control system. Developed by the not-for-profit Fieldbus Foundation, FOUNDATION fieldbus is an open, non-proprietary control technology resulting from the cooperative efforts of the world's leading plant automation equipment suppliers and end users. A powerful, all-digital, two-way communications system, fieldbus is intended for use in mission-critical applications where the proper transfer and distribution of data, control loop integrity, and the ability to integrate disparate control systems are essential.

FOUNDATION fieldbus replaces proprietary automation systems and networks with a single, open, integrated fieldbus architecture. The FOUNDATION protocol provides a complete, complementary fieldbus solution: H1 (31.25 kbit/s) fieldbus for continuous

control, and High Speed Ethernet (HSE) for high-performance control applications and plant information integration. HSE provides a high-speed (100 Mbit/s) Ethernet backbone for device, subsystem and enterprise integration, enabling a leaner plant hierarchy. It also supports high-performance control applications using the same open and interoperable function blocks as devices on the H1 network.

As shown in Figure 1, the plant incorporated an HSE system consisting of three HSE remote I/O devices, each utilizing a 16-channel analog input (AI) module for refined benzene signal acquisition; and an H1 fieldbus system comprised of three H1 remote I/O devices, four H1 pressure transmitters and one temperature transmitter for crude benzene acquisition and control. A linking device with one Ethernet interface and four H1 interfaces connects the H1 and HSE systems.
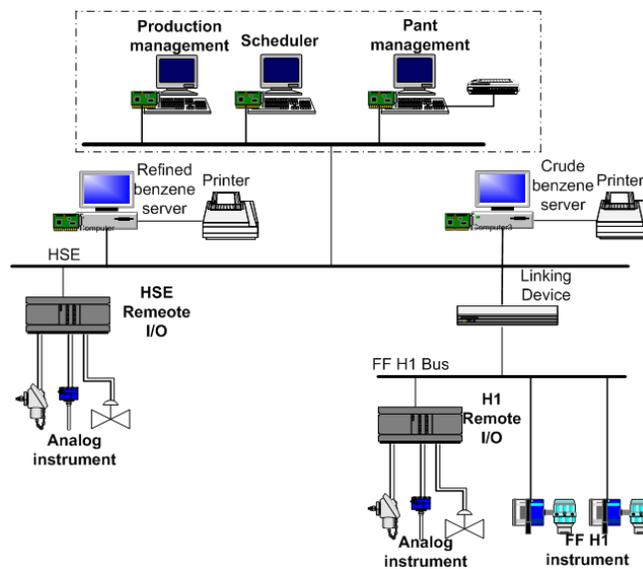

Figure 1 – Tangshan Iron & Steel's fieldbus-based control architecture.

The control system upgrade included:

1. Instrument Modernization

Two computers are used for the Human-Machine Interface (HMI) in the crude benzene and refined benzene sections. In the crude benzene section, HSE remote I/O devices are employed for data acquisition; and in the refined benzene section, H1 remote I/O devices and field instruments provide distributed control and data acquisition. The HMI computers are connected to the plant Local Area Network (LAN) as data servers.

For the analog input portion of the system, 4-20mA signals are divided into two channels: one channel is for the original display, and the other channel is connected to the AI module of the remote I/O device (See Fig. 2).
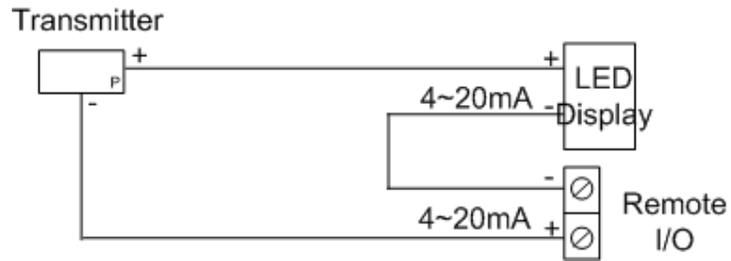
Figure 2 – Analog Input (AI) Connection.

For the analog output (AO) portion of the system, 4~20mA signals are connected to the remote I/O in a simple manner (See Fig. 3).
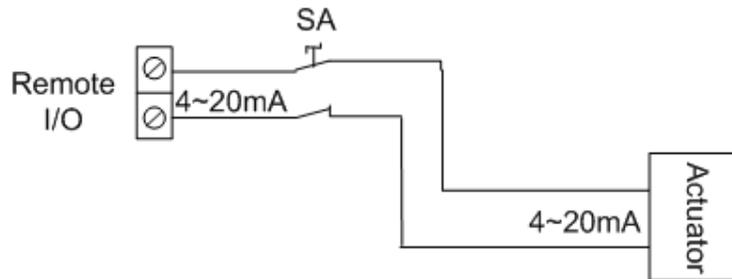

Figure 3 – Analog Output (AO) connection.

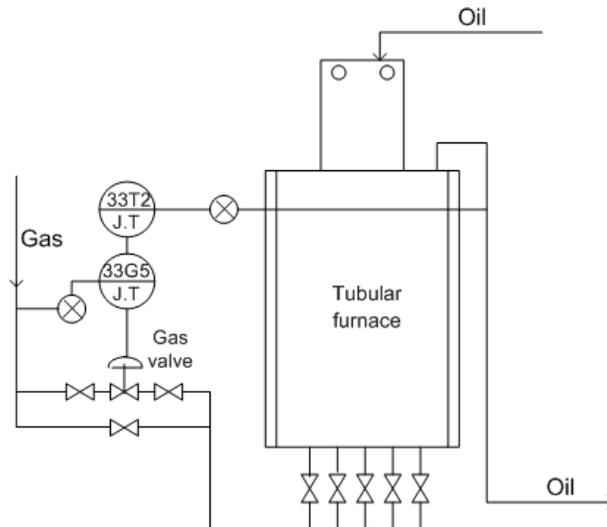The control loop transformation for the original tubular furnace is illustrated as follows:

Figure 4 – Tubular furnace process.

The temperature of the tubular furnace is a very important process parameter, as good temperature control can not only extend the life of the furnace but also guarantee the quality of benzene. Temperature control is a very lengthy process with a time constant of approximately 15 minutes and frequent gas pressure fluctuations. As a result, simple PID control cannot meet the process requirements.

Tangshan Iron & Steel adopted a cascade regulatory control scheme utilizing FOUNDATION function blocks (including AI, AO and the PID) in the fieldbus devices. Oil temperature is the main loop, and gas flow is the assistant loop. The main and assistance loops are coordinated to improve the quality of control (See Fig. 5).
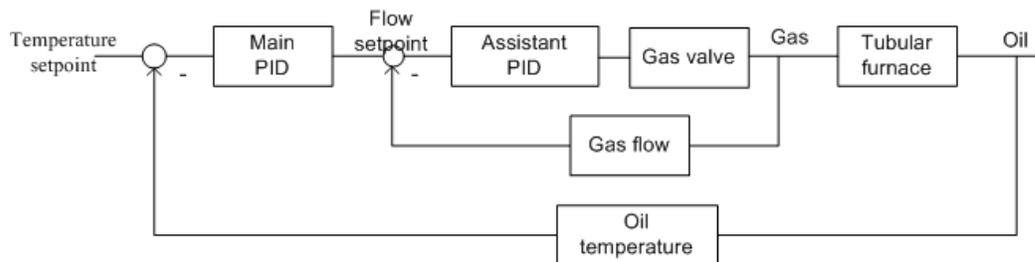

Figure 5 – Tubular furnace control loops.

2. HMI Modernization

At the Tangshan Iron & Steel facility, operator stations serve as a host for the plantwide HMI. Process values are displayed on the interface, where operators can monitor, control and adjust various key parameters. Both automatic and manual process control are supported to ensure the safety and efficiency of the plant.

The Tangshan operation uses Microcyber's MCView software for its HMI. This software can display data report forms, trend curves, operation records, history data and alarm information for the process.

The plant's operator stations have a number of important functions. These include:

- Supervise real-time data
- Process screen displays
- Interface to provide control and adjust the operation
- Alarm display and confirmation
- Running mode (manual/automatic) switch
- Set-up and display trend curves
- Adjust process setpoints and corresponding parameters
- Historical data query
- Display and print report forms

Conclusion

Based on Micorcyber's product development and engineering experience, it believes FOUNDATION fieldbus will be widely used in many process automation applications throughout China during the coming years.