

“Practical Projects of PLC-based Process Control System from the View Points of Environmental Countermeasure”

Series 1: Now, Why PLC-based Process Control System?

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In 21st century, it is sure that the earth environment will be closed-up much more than now. The overall changes that are conscious of environmental problems will be required by individual consciousness, social organization or in the process of technical development.

In these changes, many customers are selecting PLC-based Process Control System (PBPC) because this system has a good balance of both its functions and costs. With this good balance, PBPC is used in wide areas.

Through this series, we explain how PBPC is used, and how PBPC changed the existing system by introducing the PBPC applications that are related to “Environment”.

1. Introduction

The 20th century was the period that companies built the rich lives through the mass production, bulk consumption and destruction. The 21st century is the period that the environment and industrial revolution live together with our conscious of environmental problem caused from those results. This is the word our president says, “A thing left in industry society”. That means we hold many negative inheritances such as the problems of environment, resources, energy, industrial wastes, foods, population, logic and human rights, though the industry provided us rich lives. The environmental problems we have now, such as warming and environmental pollution caused by chemical matters is the global subjects. And it’s not necessary to say each company should actively try to solve these problems.

However, from the view of company level, unfortunately we should say the priority of the investment for system facility improvement is still low because bearing facility investment cost is high.

This matter is largely affected by the countermeasure done in the nation level. In this series, we introduce the process how the users grappling with environmental problem from the company moral selected PBPC. Those users are playing the active parts in new business related to environmental problems.

For series 1, we consider the basic features and effects of PBPC on the base of user application.

After series 2, we focus on the future direction of PLC process control by introducing user applications. In the articles, we also introduce our view and subjects through the discussion with users.

2. Now, Why PLC-based Process Control System?

The demand to companies was production subject, but it became to customer subject. The production subject means multiple variety small quantity production to meet the diversity of consumer needs, and individual production through the conversation with customers. According to the report from the Department of Commerce, it is said that the process of production, processing, distribution and consumption will consistently belong to consumers. We can say that this period is that of consumption subject.

It is the key for companies to be a winner in the market that providing the products with high quality and low cost to targeted customers. To meet customer's requirements, the large scaled control system required high and complicated technology is shifted to the PLC process control system with flexibility and low cost. In addition to facility downsizing, customers also require the integrated control and information system with using IT.

In PLC-based Process Control system, PLC on the FA technology, and analog control function provided by DCS are combined. And By low cost and compact size PLC provides, and outstanding functions of DCS, PLC-based Process Control System enables easy operation and engineering. For this reasons, the following features are provided.

- (1) Enables easy system configuration with low cost because hardware can be composed of PC and PLC
- (2) Uses the advantages of PLC such as maintenance and low running cost
- (3) The same control functions (ex. Loop control and so on) as DCS has are available by only adding Loop Control Unit (LCU) that is CPU for process control, though the system is PLC-based.
- (4) Unit combination enables system configuration which meets various requirements

Also, the improvement of peripheral technology that consists of the system is one of the reasons why PLC-based Process Control System rapidly comes into a wide use.

- (1) Improvement of PC reliability by the advent of Windows NT
- (2) Improvement of PLC reliability by PLC technology improvement
- (3) The advent and evolution of OPC Server, Web Technology, IT and Open Technology

Then, with introducing users' comments and application cases, we explain why PBPC comes rapidly into wide use.

3. Application Case

3.1 Rare Metal Collection: A Company (fictitious name)

A Co., was established more than one century ago. Though this company has a long history, they always challenge a new business. Especially for environmental problem, they started to recover and recycle the infection soil come from heavy metal and chlorine tract solvent by using their own technology and experience of resource and refining. For environmental problem, the conscious of environmental protection such as ISO 14000 series is getting high. However, in Japan, the countermeasure is still behind. So, A Co., actively grapples with environmental problem with a key word "Environment-friendly System".

3.2 Application

The industrial goods such as mobile phone or video game machine use various high purity metals for their function improvement and miniaturization. However, its manufacturing process produces wastes. Because of this, A Co., was required the rapid countermeasure of the technology revolution and automation of manufacturing facility.

In the rare metal collection plant, there was a big problem that they had the only method using either organic solvent with the combustibility, or harmful metal. However, this plant tried to collect melting metal by using water solution that is harmless to the environment. Moreover, the plant tried to recycle the resources from wastes. Our PLC-based Process Control System enabled those systems. In the new rare metal collection plant, adding additives into water solution and repeating separation take out the targeted metal. Depending on the reaction, there are cases that the metal remains as liquid or solid. However, to extract the target metal in a high purity of 4N, the targeted metal the all process is done with repeating the reaction by reagent, heating many times. It takes about a month to do all this process.

Each process is controlled by batch, however, the whole system is controlled continuously. In this system, 8 points of analog input for the solvent PH intake, 8 points of temperature input, 4 points of analog output and 208/112 points of digital input/output are used to control 11 loops. (Refer to Fig. 1)

- 2 position ON/OFF control

- Temperature control of reaction can (Open/Close control of steam valve *7)

- PH control of reaction can (Open/Close control of Solvent addition valve *2)

- Advanced PID

- Control of fixed quantity of liquid in batch reaction can *2

- Direction adjustment

Temperature of reaction can: * 1

PH of reaction can: * 1

Flowrate of liquid: * 1

• Accumulator

Accumulator of liquid flowrate: * 2

Depending on the process, the valve is switched to measure PH of three reaction cans with one PH electrode or amplifier. Controller performs PID control of PH, temperature and flowrate with dispersion, and those data are imported to direction adjustment.

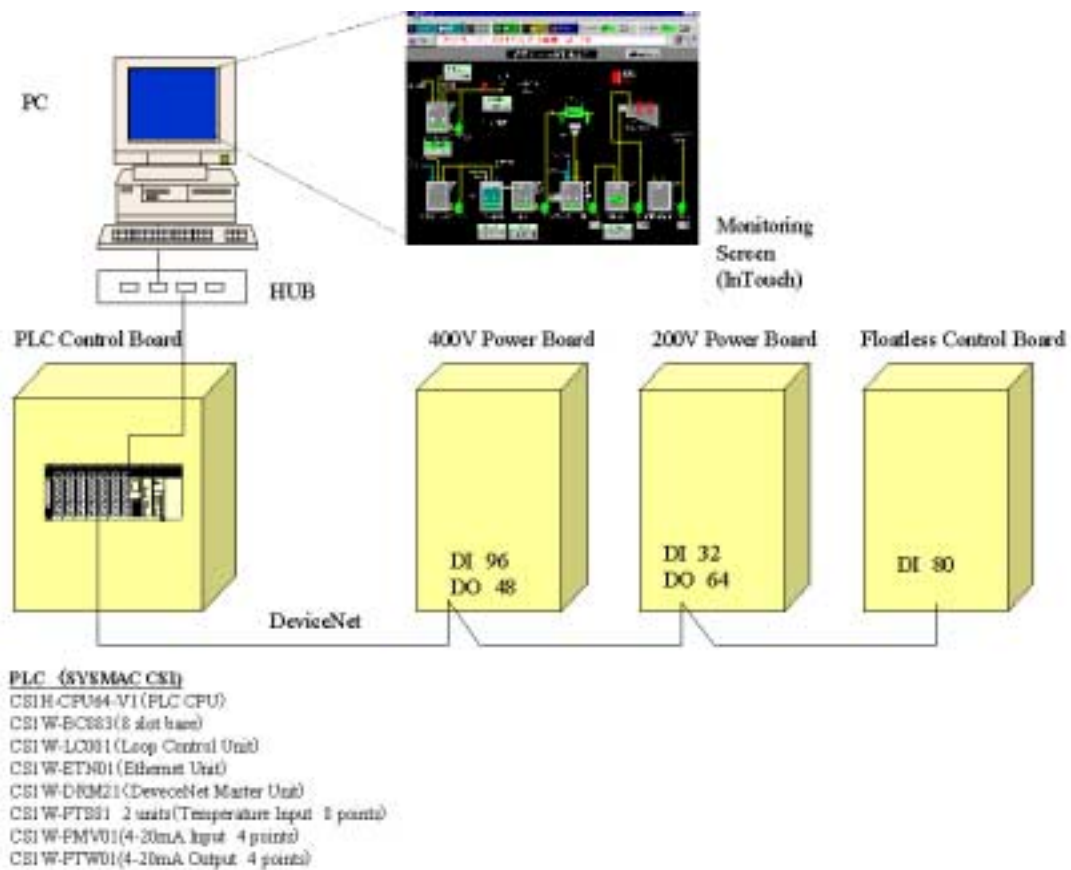


Fig.1 System Configuration

3-3 PLC-based Process Control System Solutions

In this section, we introduce the basic system configuration of PBPC in Figure 2 as below. This system is composed of LCU (Loop Control Unit) with as same features as DCS has and isolated-type process I/O units on the basis of SYSMAC CS. LCU enables advanced compound operation by programming using graphical function blocks. Also Cascade control, ratio control, feed-forward control, override control, cross limit control and so on are possible. Please refer to Figure 3 and 4.

And this control system is controlled by PLC, and monitoring software or SCADA software is used as monitoring.

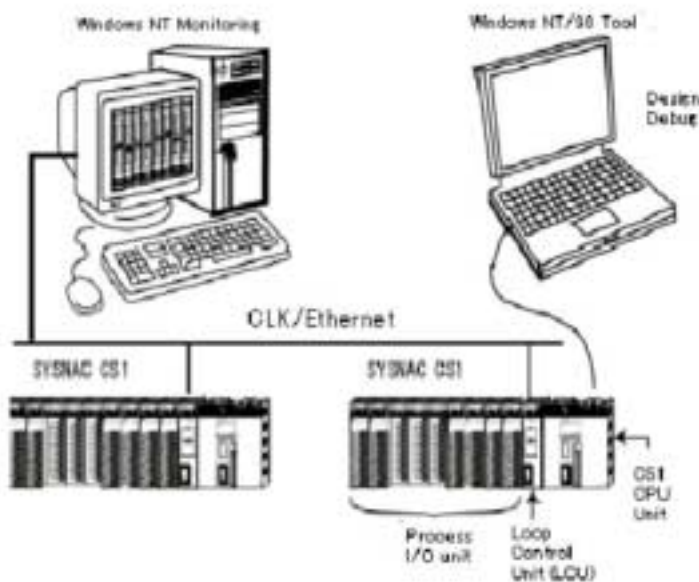


Fig.2 Basic System Configuration of PBPC

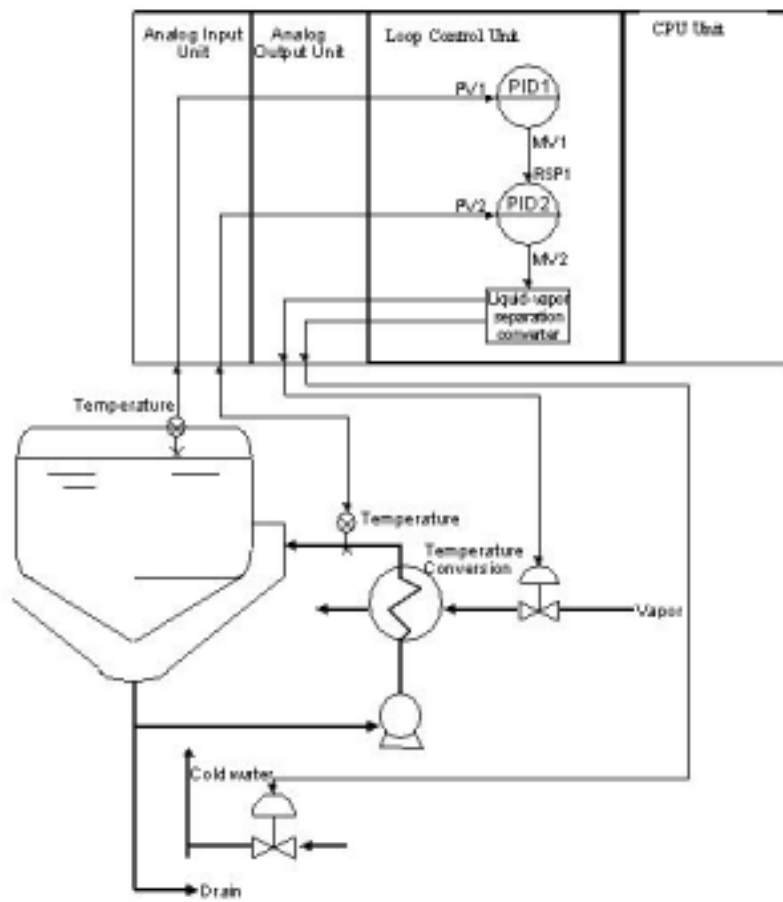


Figure 3 Temperature Control of Reactor Tank (Cascade Control)

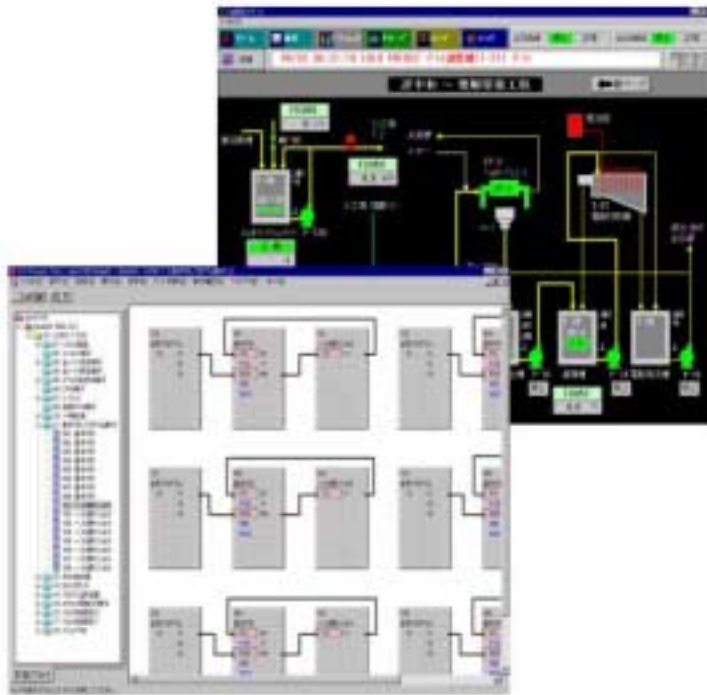


Figure 4 Screen of Tool Software and Monitor

For this application case, the system engineering company that has enough knowledge and experiences in process automation field configured this system. The collaboration of control device manufacturer and system engineering company seems to be the main current of system proposal.

Here are comments from End Users and Engineers

“Enables stable process control system based on PLC”

Before using PLC-based Process Control System these processes are manually operated. But now, all processes except filtration are automatically operated. Since the operation started in last July, the system is working without stopping.

They satisfy these results.

“Enables analog control by combination of function blocks”

The programming by using function blocks is very easy to understand. It took only 1 day to understand PLC-based Process Control, though it took 5days to understand DCS system.

“Expandability of Loop Control Unit”

The system could be delivered in a short period. It is one of the reasons to use PLC-based Process Control System that one station can have maximum 96 loops. Maintenance, modification and expandability are highly evaluated by customers.

“PLC-based Process Control System with low cost”

Adopting PLC-based Process Control System enables reduction of hardware costs. So, engineering company can keep all parts for maintenance to provide 24-hours maintenance system for customers.

“Expectation for PLC-based Process Control System with low cost”

For tool software, the operational function has been improved, however, more improvement of deback function operation is required. Also strengthening of reliability including redundancy is expected.

PBPC is highly evaluated because it has a good balance of price and function and is suitable for various types of application.

In next edition, we introduce the case for sludge treatment reproduction center where PBPC is selected as its control system.

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