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COOLING WATER FLOW CONTROL WITH PLC

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Abstract: The paper proposes a solution for controlling the flow of cooling water on the first zone of secondary cooling using a PLC SIEMENS PLC. This solution has been chosen because programmable logic machines can be programmed either from the system logic equations or from control schemes made with contacts and relays or with logic circuits with static commutation, the programs for the automatic are very flexible, the changes to the system are relatively easy to implement. The language of this total automation concept is STEP7, a language that is used to configure SIMATIC components to assign parameters, and last but not least, to program them. The communication between the SCADA-WinCC server and the programmable machine is based on the Ethernet TCP / IP based on the CP373 communication module.
Keywords: control, flow, plc, cooling, continuous casting, sensors

1. INTRODUCTION

A feature of today's technology is the multitude of facilities available to the developer to build a human-computer interface. Thus, we have components that have both input and output functionality, such as dialog boxes. If we also take into account the fact that there are several possibilities for doing the same operation, for example, we can select an object with the help of mouse or combinations of characters, and that an interface includes several technologies in it, we draw the conclusion that it is quite difficult to describe the diversity of human-computer interfaces without having an instrument to use [1],[2],[3]. In this sense, we introduce the notion of interface by understanding the dominant features of an interface, characteristics that are determined by both the graphical and interaction techniques.

These electronic devices are much more reliable than classical installations, being designed to work in the industrial environment.

≡ are resistant to moisture, dust, electromagnetic fields etc.;
≡ have fewer physical contacts
≡ do not have moving elements, compared to classical switching elements - have a low wear rate over time;
≡ maintenance is much easier;
≡ customize for different applications
≡ changing the operating parameters is done quickly, simply by changing the program parameters;
≡ reduced gauge;
≡ high operating speed;

So the diversity of interfaces is given by the way graphics are designed, both in terms of the graphic layout and how they interact with them [4],[5]. Figure 1 shows the PLC system control interface, it is the first welcome screen that displays system components and base readings. In order for the WinCC application to communicate with the programmable machine and other elements of the automated system (servers, databases, automation systems and auxiliary SCADA), certain drivers must be installed and some protocols configured. The communication between the SCADA-WinCC server and the programmable machine is based on the TCP / IP Ethernet base using the CP373 communication module[1],[6],[7].

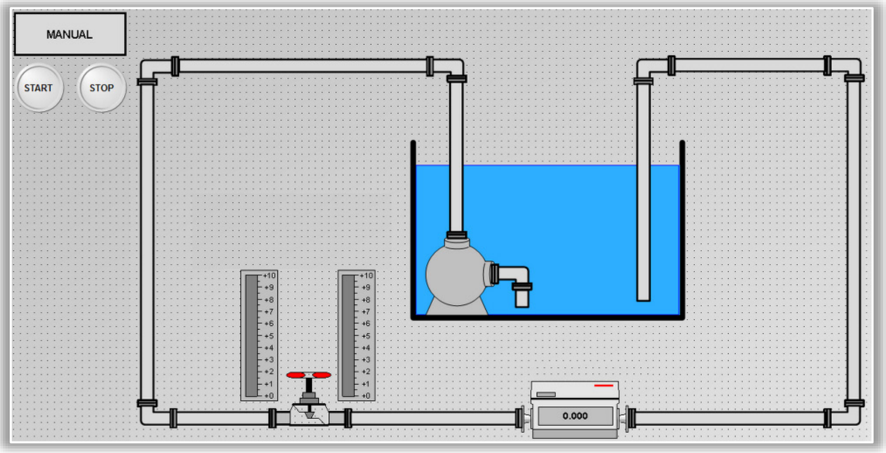

Figure 1: SCADA control interface

2. EXPERIMENTAL STATION

In Figure 2 is the SIEMENS PLC configuration and the experimental stand. The system is powered by a 24V source that can be seen at the bottom left of the picture, the list of components used is found in Table 1.

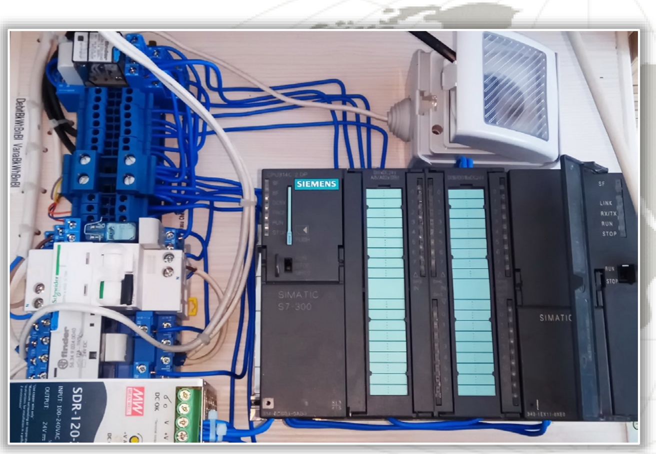

Figure 2. PLC wired into the system

Table 1. Inputs and outputs of the PLC

Inputs	Outputs
Potentiometer	Solenoid
Start button	Pump relay
Stop button	
Flowmeter	
Solenoid	

The cooling water pipe has a flowmeter that generate a PLC-readable current signal at the terminals and displayed in the SCADA interface. By simulating the inlet temperature with the potentiometer (in the continuous casting process, the potentiometer will be replaced by a temperature sensor) the programmable controller will command the closing or opening of the solenoid which will increase or decrease the water flow in the cooling circuit and, implicitly, control the temperature[8],[9],[10].

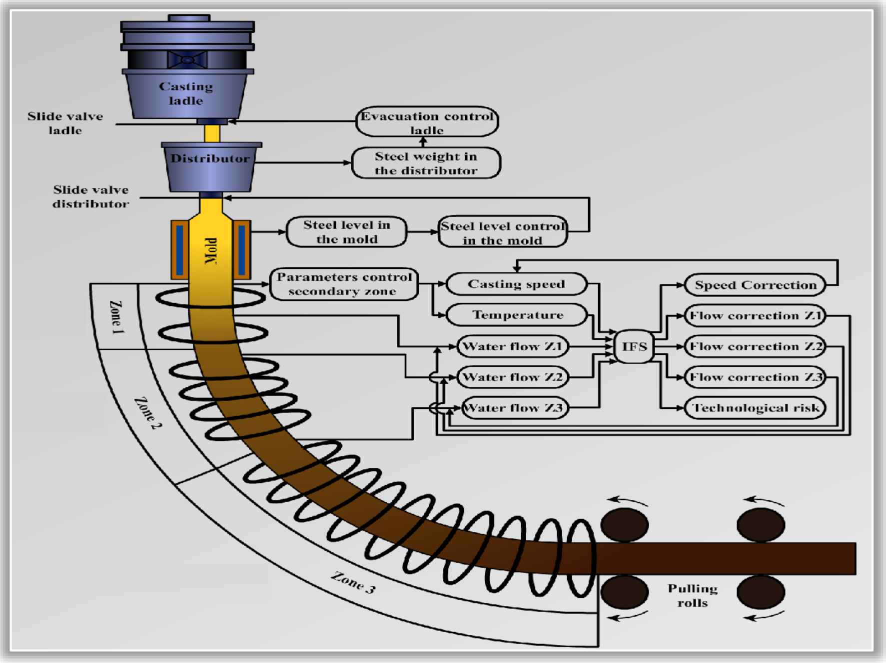

Figure 3. SCADA interface for cooling zone selection

3. EXPERIMENTAL RESULTS

Here are some of the experimental results. On the PC we can see the values from the valve, the actuator, the potentiometer and the flow rate. Also this values are shown in graphic form.

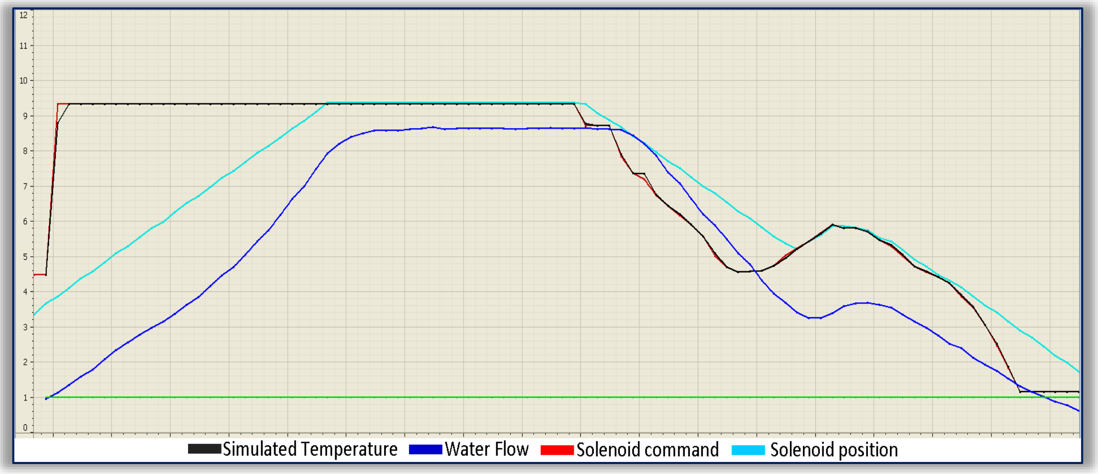

Figure 4. Results of the simulation for Zone 1

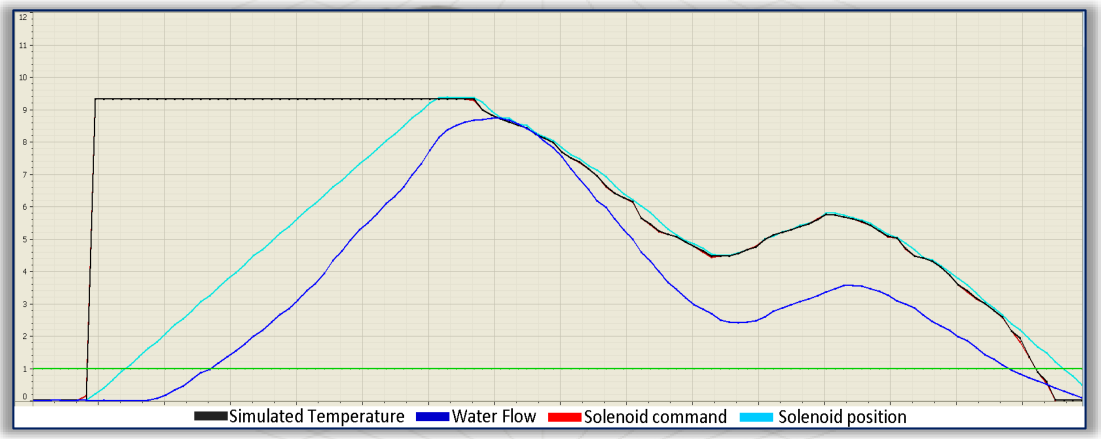

Figure 5. Results of the simulation for Zone 2

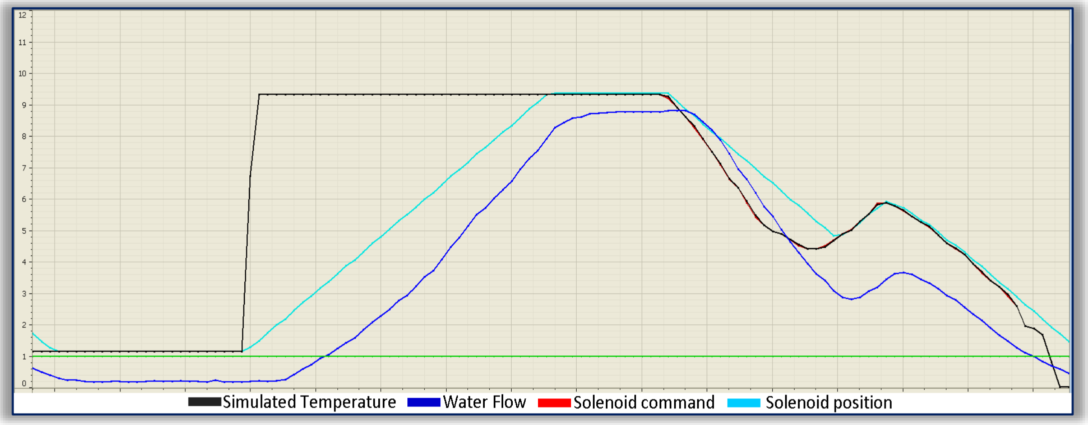

Figure 6. Results of the simulation for Zone 3

In Figures 4-6, we can see the temperature between 1600°C and 1650°C, represented in black, the temperature is entered manually into the system using the potentiometer but simulating the actual parameters of the continuous casting. We can see how the control for selenoid is calculated on the basis of temperature and flow in all three zones of secondary cooling from the continuous casting of steel.

4. CONCLUSIONS

After the system was tested and validated by simulation in Matlab, the system was implemented and tested on the PLC control bench in this paper. Analyzing the simulation results, it is noted that, irrespective of the values generated at the input, the system develops the necessary corrections for the secondary cooling water flow, which confirms the validity of the system operation. It is considered that, from a qualitative point of view, the use of the PLC system is an efficient, practical and easy to implement method.

Acknowledgment

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