RAČUNARSKO UPRAVLJANJE ENERGETSKI EFIKASNIM SISTEMOM ZA STERILIZACIJU DRVETA

COMPUTER CONTROL OF ENERGY EFFICIENT WOOD STERILIZATION SYSTEM

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Na postojeći sistem za sterilizaciju drveta nadograđen je savremeni sistem za regulaciju procesa u cilju povećanja energetske efikasnosti, pouzdanosti, kvaliteta proizvoda i komfora korisnika. Postojeći ON/OFF regulator temperature zamenjen je kontinualnim PID regulatorom sa trofaznim tiristorskim faznim regulatorom na izlazu. Zadržano je postojeće merenje temperature u zonama komore sa drvetom ali su isti signali uvedeni i u novi sistem, gde su po određenom algoritmu iskorišćeni za definisanje referentne temperature PID regulatora.

Ključnereči: *PID regulator; sterilizacija drveta; energetska efikasnost; merenje; temperatura*

This paper describes the design of hardware and software for computer control of energy efficient wood sterilization system. The existing ON / OFF temperature controller has been replaced by a continuous PID controller with a three-phase thyristor phase controller at the output. Temperature measurements in 5 zones of the chamber with wood was performed with Pt1000 probes and they were used according to a certain algorithm to define the reference temperature of the PID controller that controls the power of the steam generator heater

Key words: *PID regulator; sterilization of wood; energy efficiency; measurement; temperature*

1 Introduction

A modern process control system has been upgraded over the existing wood sterilization system in order to increase energy efficiency, reliability, product quality and user comfort. The existing ON / OFF temperature controller has been replaced by a continuous PID controller with a three-phase thyristor phase controller at the output [1-4]. The existing temperature measurement in the zones of the chamber with wood was retained, but the same signals were brought to the new system, where they were used according to a certain algorithm to define the reference temperature of the PID controller [5,6].

2 Implementation

2.1 Hardware

Temperatures in the five zones of the chamber with wood are measured by PTC sensors Pt1000 which, combined with 10kΩ resistors, form voltage dividers connected to the multiplexer 4051 from which negative pulses are obtained as a "call" of an individual sensor. The sensors were immersed in hot water whose temperature was changed in the range from 50 °C to 80 °C and the signal level at the distributor output was measured, which determined the temperature of the output signal in a given temperature range:

$$T=-1666,7\ U-320$$

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where T is the temperature of the observed zone in °C, and U is the output voltage of the distributor [1].

Figure 1 shows the shape of the output signals for the temperature T = 70 °C, while on the Figure 2 signal amplification and conditioning from the Pt1000 sensors and input to the 5 analog inputs of the AD / DA converter NI 6001 USB are shown [7,8].

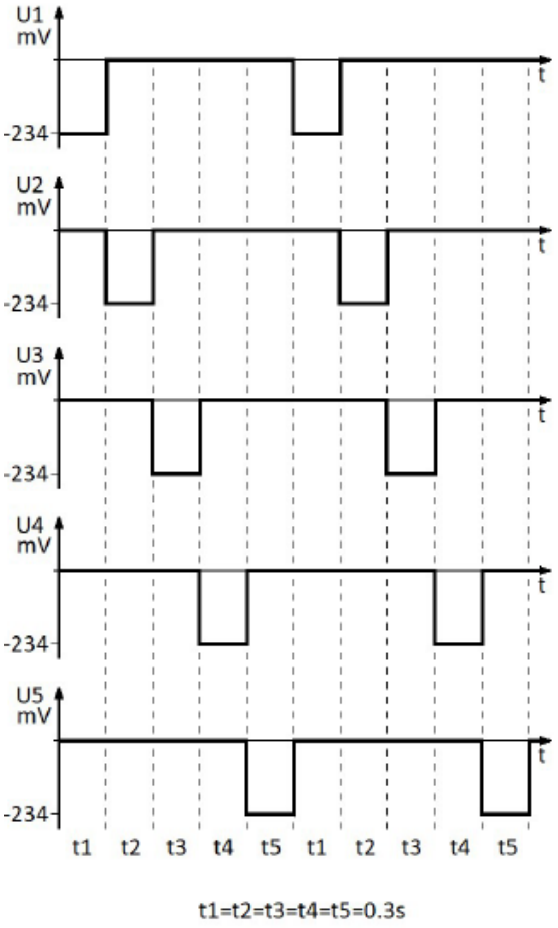

Figure 1. Signal shape from the temperature sensors

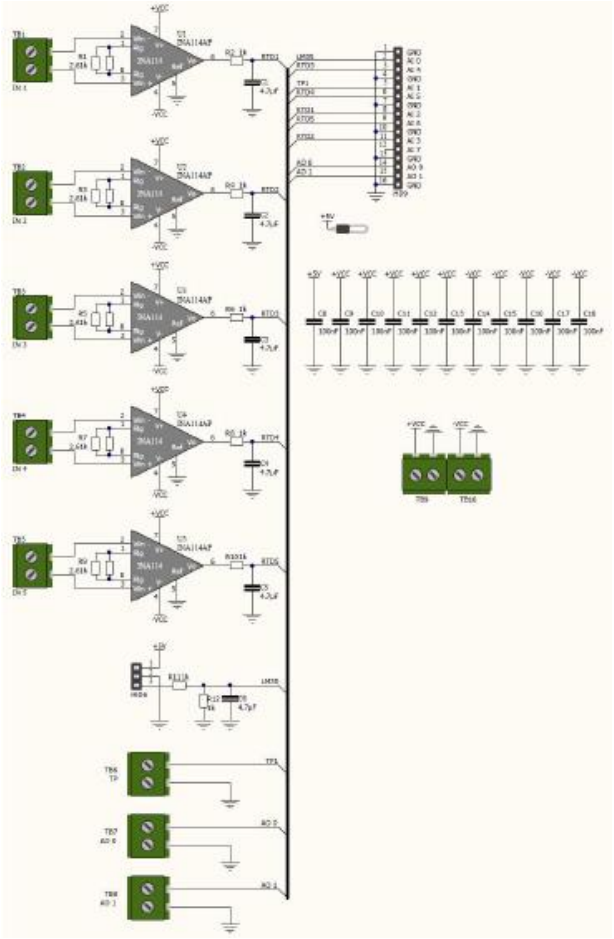

Figure 2. Signal amplification and conditioning

2.2 Software

The signal processing and process control are performed within the LabVIEW environment. Signals from the analog inputs of the DAQ card are imported into this environment via the DAQ Assist block (Figure 3). The output of this block is a dynamic structure consisting of six signals. A signal corresponding to the output of the protection module appears at the first output of the DAQ Assist block, which is averaged, multiplied by the appropriate constant and finally displayed on the Temperature indicator in the steam generator [1]. At the next five outputs, signals corresponding to the voltages of the Pt1000 sensor appear. These signals are averaged, their offset is adjusted as well, and converted to temperature using the calculation block (Formula Node), according to equation, and displayed on the diagram (XY Graph). The chamber zone temperature data define the setpoint for the PID steam generator temperature controller (PID) according to the algorithm in Figure 4. At the output of the PID block, a Control signal is obtained, which is displayed on the indicator and on the time diagram.

Other elements of the program block diagram are numerical constants, numerical indicators and graphical indicators, as well as control blocks for setting the gain of the controller, reference temperature and channel selection frequency [1].

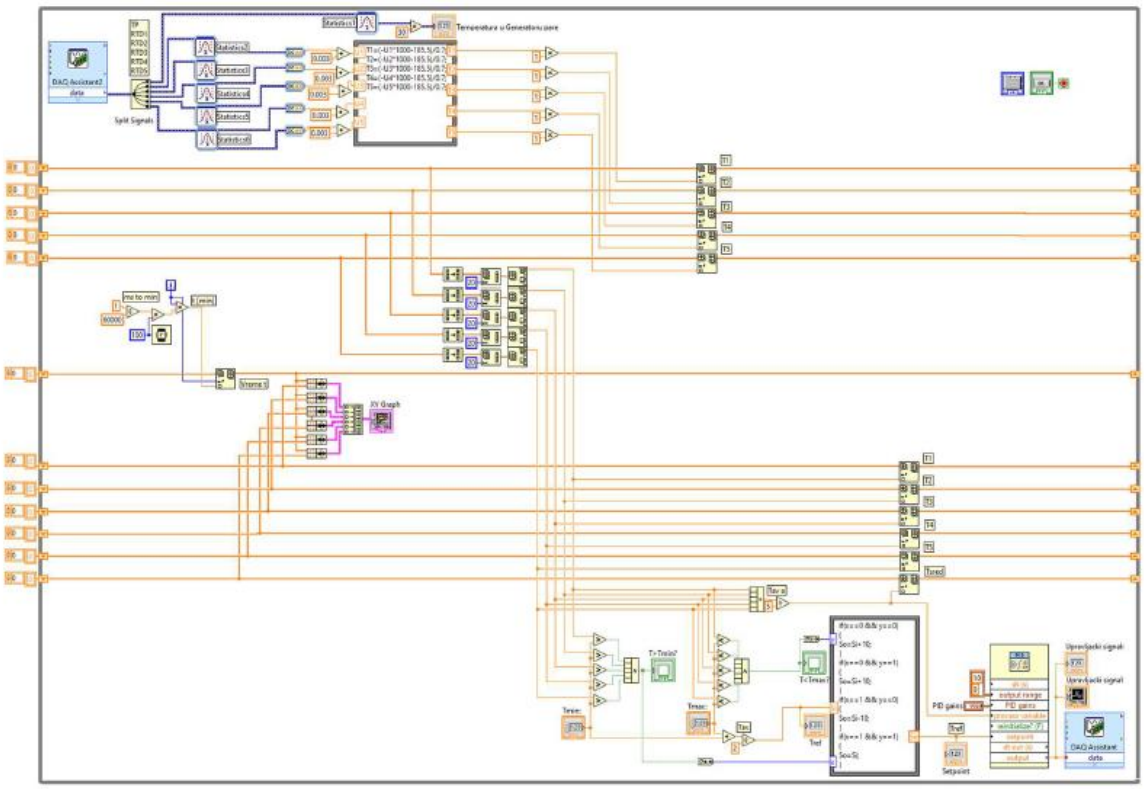

Figure 3. Block diagram in LabVIEW

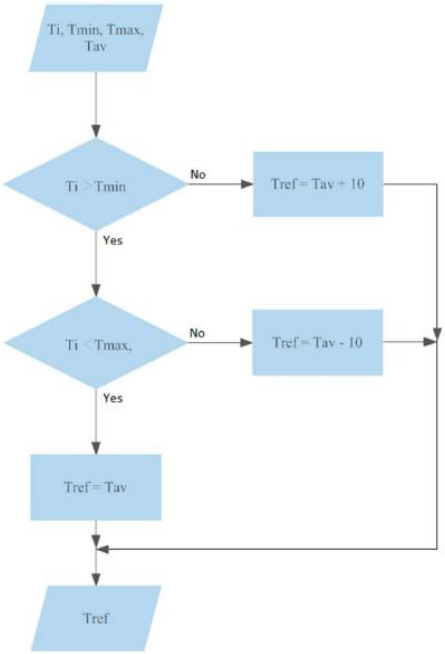

Figure 4. Algorithm for determining the setpoint temperature of the steam generator

In Figures 5 and 6 parts of the Front Panel are shown, within which the temperature and output signal are monitored, as well as the setting of the selection frequency, reference temperature and gain of the PID controller.

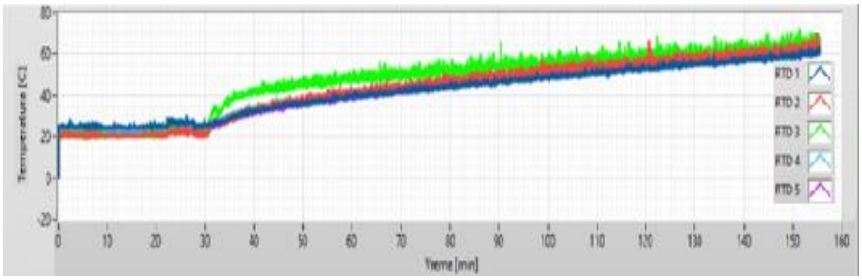

Figure 5. Front panel (monitoring the temperature signal)

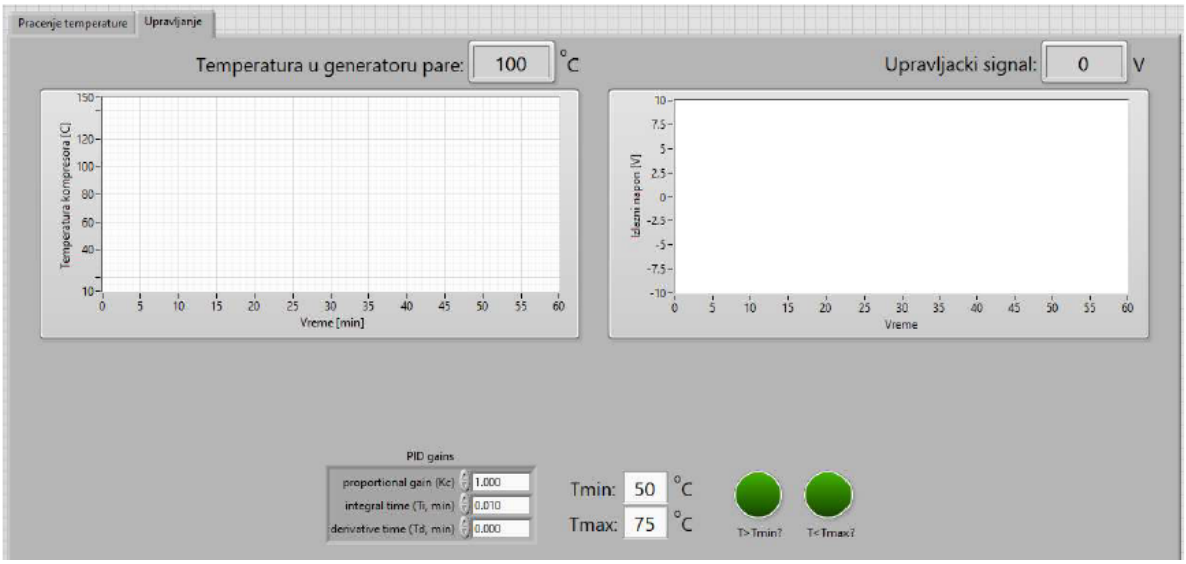

Figure 6. Front panel (setting controller parameters and monitoring output voltage)

3 Results

Based on the presented construction documentation, a system for wood sterilization was realized in DOO MS Kablovi in Paraćin. The system is based on an existing plant where the ON / OFF controller has been replaced by a PID controller. The new solution also brings a higher degree of protection against accidents. Significant energy savings are also achieved by the optimization algorithm for defining the set temperature of the steam generator based on the temperatures of the zones in the chamber. Computer measurement and control was performed in a LabVIEW environment, with its own application software solution (1).

4 Acknowledgement

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