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SELECTING THE ADJUSTMENT LAW OF THE SCADA SYSTEM CONTROLLING THE TEMPERATURE IN THE DRYING DRUM DURING THE DRYING PROCESS OF COTTON

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A B S T R A C T

In cotton ginning enterprises, it is of great importance to dry cotton before cleaning it. Drying cotton is carried out using thermal energy. The main disadvantage of modern drying drums operating in enterprises is the fact that the temperature rises or falls, which, as a result, causes a violation of the quality of the product. If the raw materials of cotton are not well dried in the later stages, that is, the processes of cleaning, ginning have a negative effect on the productivity of work and the quality of raw materials. If the drying agent temperature is high during the drying process, the fiber quality during the Jinning process and lead to damage to the seed. With this in mind, based on the results of this scientific research, it will be advisable to choose the law of adjusting the Scada system, which controls the temperature in the drying drum.

K E Y W O R D S

Automatic adjustment, regulator, stabilization, automatic regulator, adjustable body, adjustment law, PID setting, transition period, proportional, Integral, differential.

Introduction

Automatic adjustment is an automation system that includes a set of methods and tools that make it possible to ensure with the necessary accuracy a certain state of the technological process for a certain period of time or to pre-determine the course of this process in accordance with specified process conditions in accordance with a pre-established law.

Systems using this type of control were widely used in practice at the end of the last century, but now their improved prototypes are used to regulate temperature, level, pressure and flow in various industries such as metallurgy, oil and gas, mechanical engineering, energy [1].

A regulator is an automatic control device that operates in a closed loop and is designed to stabilize any parameter.systems using this type of control were widely used in practice at the end of the last century, but now their improved prototypes are used to regulate temperature, level, pressure and flow in various industries such as metallurgy, oil and gas, mechanical engineering, energy.

A regulator is an automatic control device that operates in a closed loop and is designed to stabilize any parameter. According to the type of setting parameter, they can be divided into pressure, temperature, power, voltage, etc.

An automatic controller is a set of devices connected to a controlled object to adjust its output value. A measuring element is added at the output of the object, which controls the output value, and an executive element is added at the regulated body of the object. If the regulated parameter of the object deviates from the set value, the regulator, in accordance with the law introduced into it, forms a control action on the regulated body in order to reduce the deviation [2].

2. The heat entering the drying chamber is spent on:

The law of regulation that makes up the regulator refers to the relationship between the regulated parameter and the position of the regulatory body. Regulators are usually called in accordance with the law of adjustment, which it implements [2].

Brief description of the basic laws of regulation:

1. Proportional (P-regulator):
• Advantages: speed;
• Disadvantages: adjustability and residual deviation of the parameter;
• Features: Can be used to adjust objects without self-leveling and with frequent load deflection.
2. Integral (I-regulator):
• Advantages: in stable operation, the adjustable parameter value remains constant regardless of changes in the load of the object (astatic regulator);
• Disadvantages: long setup time;
• Features: Does not apply to objects without self-leveling.
3. Proportional Integral (PI controller):
• Features: It can be used for both self-leveling and self-leveling objects, when high adjustment accuracy is required with a large but smooth load change.
4. Proportional-integral-differential (PID)Proportional Integral (PI controller):
* Features: It can be used for both self-leveling and self-leveling objects, when high adjustment accuracy is required with a large but smooth load change.
5. Proportional-Integral-Differential (PID)
* Features: used in facilities that do not allow static errors, their load changes frequently, and there is also a delay. The PID controller moves proportionally to the deviation, integral, and rate of deviation of the controlled parameter.

PID controller-This system has one sensor element and processes one input signal per controller, so it is a single circuit control system. Such systems use dozens of ways to adjust the parameters of regulators. calculation of the transmission coefficient of the KP regulator, constant integration of ci, constant differential cd-direct adjustment of the regulator.

3. Research Methodology

The Ziegler-Nichols method. Several methods were used to adjust the PID controller, one of which is the Ziegler-Nichols method, based on finding the reaction parameters to a single jump of an object with a and L, as shown in Figure 1. Based on these parameters, coefficients of various adjustment laws are calculated, and formulas for calculating them are presented in Table 1 [3]. The Ziegler-Nichols method. To adjust the PID controller, there was:

$$k_p = \frac{1,2}{a} = \frac{1,2}{1} = 1,2$$
$$k_i = \frac{0,9 \cdot L}{k_p} = \frac{0,9 \cdot 2}{1,2} = 1,5$$
$$k_d = \frac{0,5 \cdot L}{k_p} = \frac{0,5 \cdot 2}{1,2} = 0,83$$

Table 1
Formulas for calculating regulator coefficients using the Ziegler-Nichols method for surge response

Adjustment	kp	ki	kd
P	1/a	-	-
PI	0,9/a	3·L/kp	-
PID	1,2/a	0,9·L/kp	0,5·L/kp

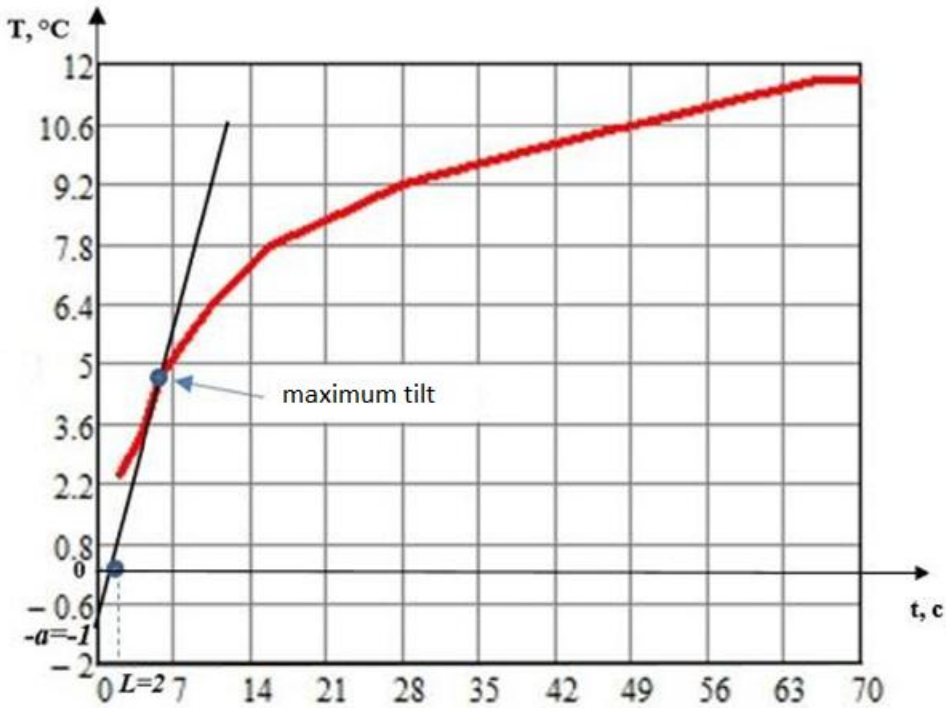

Figure 1. Characteristics of the transition of object a and l with response parameters to a single jump

To assess the quality of the system based on the settings found in the MATLAB software, a flowchart of the system was modeled (Fig.2). Thus, the transient characteristic of the PID-controlled system is obtained (Fig. 3) and the main temperature quality indicators are determined from it.

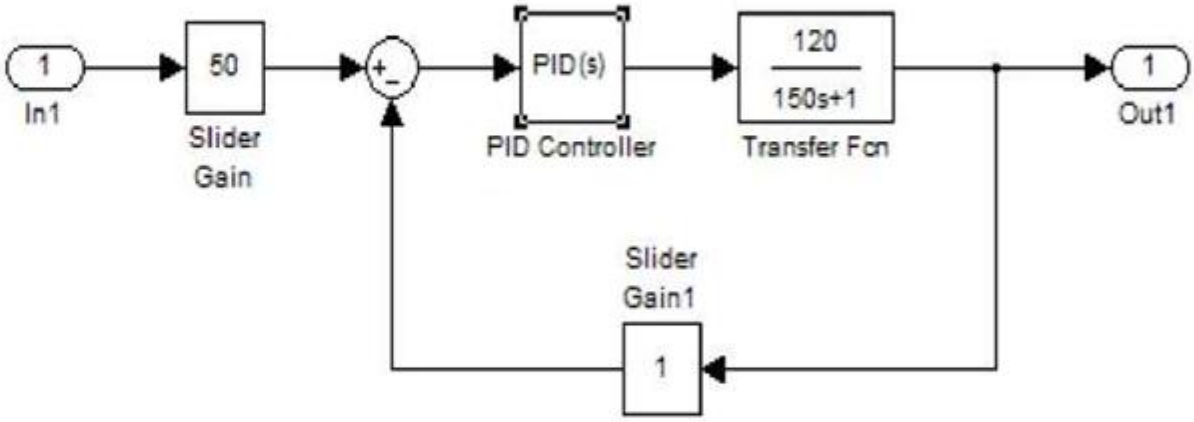

Figure 2. Temperature control scheme in the drying drum

The CHR method-the quality criterion of the second studied method of regulating CHR (Chien, Chrones, Resvik) is maximum if it is not overestimated or overestimated by more than 20%, the growth rate is maximum, this method allows for a greater reserve of stability than the previous one [4].
The CHR method is obtained by observing changes in the regulator parameters at a given point (Table 2). The choice of system parameters depends on the priorities that the developer sets for a specific technological process: the quality of adjustment depends on changing a given point or mitigating external influences [5].
The method in question uses the same parameters a and L as the Ziegler-Nichols method, but has proportionality coefficients in the formulas. Since the quality of adjustment when changing a given point is a priority factor for the system under study, the search for adjustment coefficients of the regulator is limited to the first system of regulator parameters exceeding 20%.

Table 2 Formulas for calculating the coefficients of the regulator using the CHR method to respond to parameter changes

Adjustment	Without exaggeration			With a 20% overestimation		
	kp	ki	kd	kp	ki	kd
P	0,3/a	-	-	0,7/a	-	-
PI	0,35/a	1,2·L/kp	-	0,6/a	1·L/kp	-
PID	0,6/a	1·L/kp	0,5·L/kp	0,95/a	1,4·L/kp	0,47·L/kp

Calculation of the PID controller settings using the CHR method:

$$k_p = \frac{0,6}{a} = \frac{0,6}{1} = 0,6$$

$$k_i = \frac{1 \cdot L}{k_p} = \frac{1 \cdot 2}{0,6} = 3,33$$

$$k_d = \frac{0,5 \cdot L}{k_p} = \frac{0,5 \cdot 2}{0,6} = 1,66$$

4. Experimental results

In the process of analyzing the transient characteristics of the system with the adjustment of the parameters of the PID controller using the Ziegler-Nichols method based on the transition graph using the MATLAB package, the following system indicators were obtained (Fig. 2):

$y_{og'}$=50 - Steady deviation when setting the value to 50;
t_n=9,95 - Setting time;
σ=63,5% - maximum excess;
δ=3 - the number of overdoses;
y_{max}=81,8 - the maximum value of the adjustable amount.

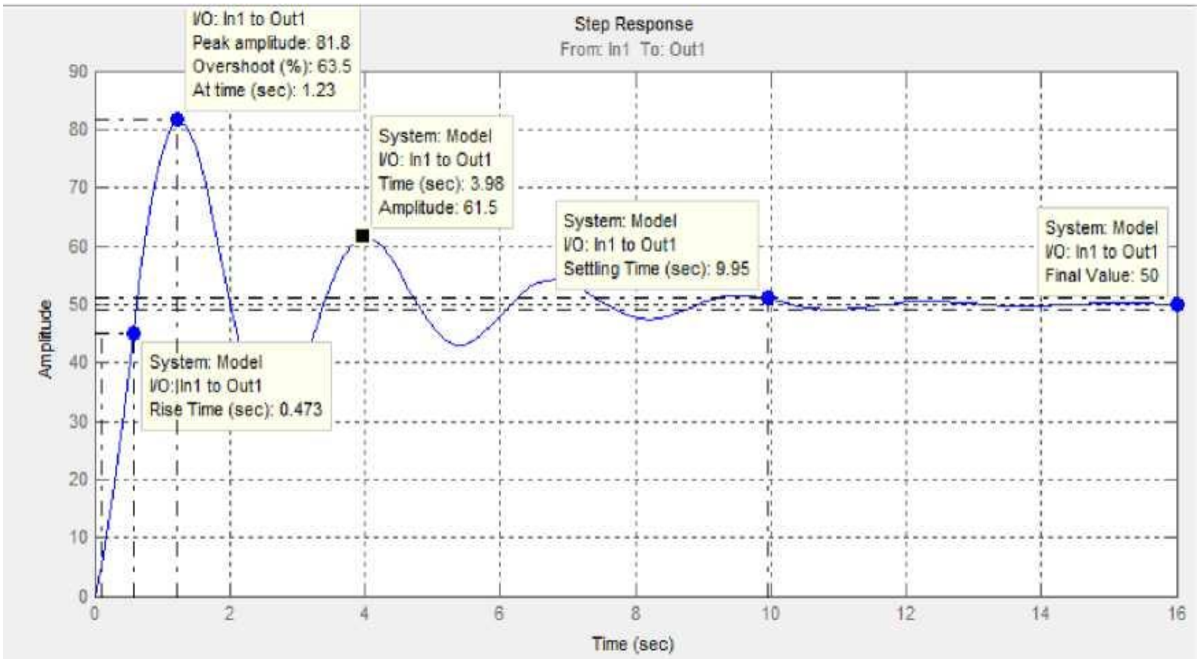

Figure 3. Transient response of the system by adjusting the coefficients of the PID controller using the Ziegler-Nichols method

In the process of analyzing the transient characteristics of the system with parameter adjustment using the CHR PID controller based on the transition graph in the MATLAB package, the following system quality indicators were obtained (Fig. 4):

$y_{og'}$=50 - Steady deviation when setting the value to 50;
t_n=15,7 sek - Setting time;
σ=65% - maximum excess;
δ=3 - the number of overdoses;
y_{max}=82,5 - the maximum value of the adjustable amount.

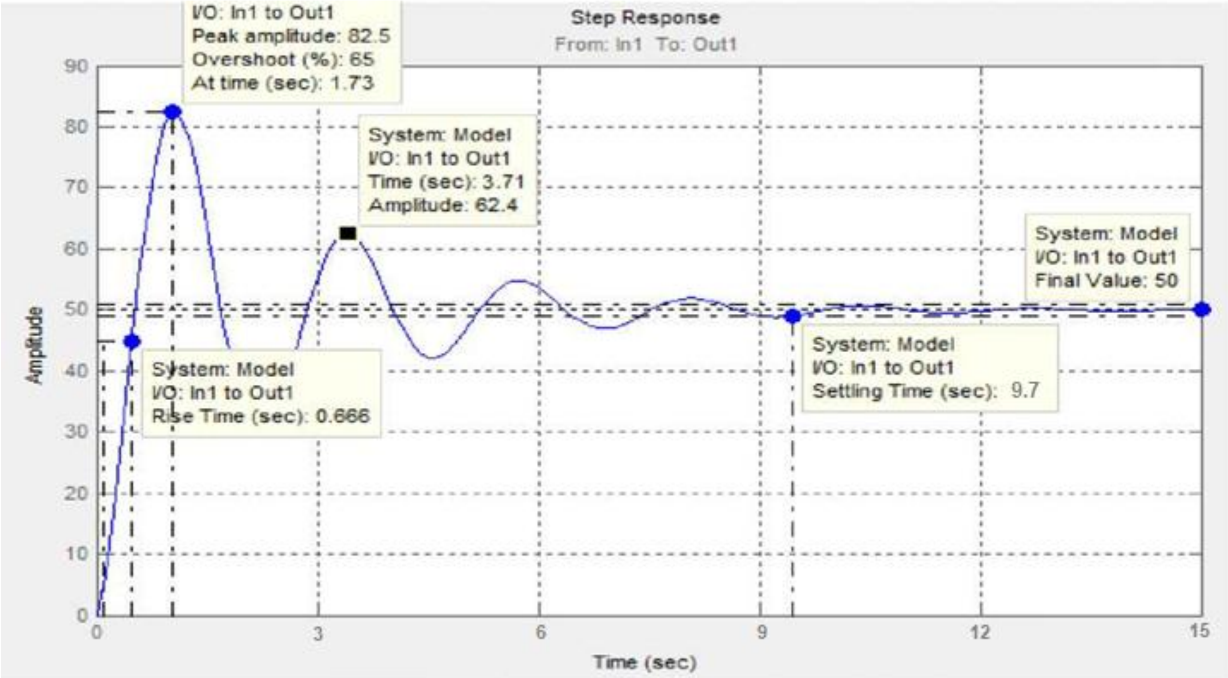

Figure 4. Transient response of the system by adjusting the coefficients of the PID controller using the CHR method

5. Conclusion

The regulator settings obtained in the Ziegler-Nichols method allow us to conclude that the transient process is affected: fluctuations in the system fade slowly, exceeding the permissible norms leads to a decrease in the accuracy of the system as a whole, but these results are explained by the fact that the method itself is based on only two parameters. The regulator settings obtained by the CHR method allow us to conclude that the nature of the transient process is affected: fluctuations in the system, as in the previous method, slowly fade, overloads also exceed the permissible limits, and time adjustment increases, which reduces not only the accuracy of the system, but also its quality.

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