Optimization of the Controller`S Parameters of the Gas-Diesel Generator Unit

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Abstract - **This article gives the rationale of the possibility of using PID control systems in the gas-diesel engines.**

Keywords - **electric power, power distribution, gas diesel engine.**

I. Introduction

Gas-diesel engine is object of the regulation for PID-regulator. Dynamic parameters of the object of regulation by control and disturbance affection are characterized by transient curve that shows oscillatory of the processes with natural frequency ω_0 and coefficient of oscillation m_0 [1].

If there are disturbing influences on the system, parameters of the PID regulator, obviously, must be chosen so as to provide system with the degree of damping that eliminates oscillatory processes in output parameter. To reach this goal, let`s analyze possible reductions in rate of oscillation with numerical values for the system for different parameters of PID-regulator.

II. Fundamental Information Exposition

The relation between the settings parameters T_D, k_p and m_c, m_0:

$$m_c = \frac{\frac{T_D}{2xT_0}k_0k_p + 1}{\left(\frac{m_0^2+1}{m_0^2}\left(k_0k_p+1\right) - \left(\frac{T_D}{2xT_0}k_0k_p+1\right)^2\right)^{1/2}}$$

From the last expression as an analyzing result can be observed, that index m_c may increase, that is mean that process of oscillation in the system will decrease.

For a set structure of the control object and the known indeterminations of its parameters need to find coefficients K_p, K_I and K_D of the regulator. These coefficients of the regulator were selected in accordance to methodology of Ziegler-Nichols that was designed for optimal adjustment of PID-regulators.

When initial values of adjustable parameters are K_p=11,4; K_I=10; K_D=46,4 and oscillation nature of transient processes, result of the optimal processes is shown in fig.1. This figure shows up two curves correspond to the transient processes in the system with initial values and the values of the coefficients K_p=19,8; K_I=0,9 and K_D=44,7, that were determined after optimization of the PID-regulator.

Great attention is currently paid to the development of self-adjusting automatic regulation systems. That is because in the industry, including energetics, automatic regulation systems are widely used, which are often not optimally adjusted, which leads to a significant aggravation of electricity quality, economic losses and in some cases for emergencies.

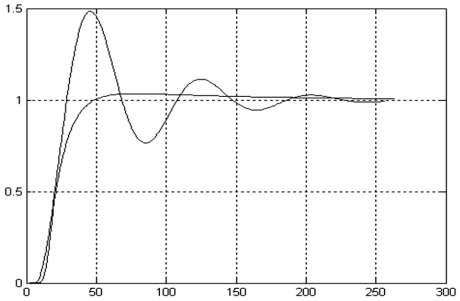

Fig.1 Regulator`s parameters optimization

The basic principle of determining coefficients of the PID-regulator is to set step control signal to object of regulation (enable or disable some of the load) and check the reaction of the object. Then, coefficients of regulator are determined by the transition function from empirical formulas.

Integral criteria is commonly used for assess the quality of regulation for a step input action, accordance to the area over the interval of time t_p, that is limited by diagram of the transition process $y(t)$. Integral of the modulus of the transition process is the most convenient measure of optimal functioning of the system.

$$I_{y(t)} = \int_0^{t_p} | y(t) | dt$$

In this case, the effect of negative values of y(t), that accrue in oscillatory systems, is eliminated. Meantime, the response impulse surface with such an integral has the most predictable character from point of view of the numerical search procedures.

III. Conclusion

Using a numerical optimization method allows to achieve a compromise that provides the minimum value of the summary integral criterion by modulus is subject to restriction of the stability margin. To reach the specified stability margin in searching and optimization of tuning parameters by simulation modeling are used direct measures, such as dumping coefficient, which is inserted to the objective criterion.

References

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