HEAVY MACHINERY - HM 2011, 1-6
ISBN 978-86-82631-58-3
Paper accepted: 27.05.2011

Auto-tuning of PID Controller for System Turbine - Condenser in the Thermal Power Plant

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This paper contains auto-tuning of PID controller for level in condenser of thermal power plant Gacko. It shows method of compensation static load disturbance during relay feedback test. This auto-tuning is carried out with saturation relay, but disturbance rejection is obtained using automatic bias. In this way, errors in estimating of the ultimate gain and ultimate period are minimized. Simulation of mentioned test is performed on the mathematical model of system turbine-condenser, which are taken as second–order process.

Keywords: PID control, level in condenser, saturation relay, disturbance rejection, automatic bias.

1 INTRODUCTION

The application of PID controllers in industry is subject of many researches. This paper explores their role in controlling of level in condenser in the thermal power plant Gacko. System turbine-condenser in this power plant was taken as object of research.

Adequate tuning of PID controllers enables appropriate static and dynamic system behaviour. Large numbers of auto-tuning methods are derived based on Ziegler and Nichols and later Åström and Hägglund works. Each of them has main idea to tune PID controller with as little as possible information about process response [1]. In this paper, simulation of relay feedback test is carried out at the system turbine-condenser. They are modelled together as second order system in order to improve presenting of object's behaviour. This approach enables and suggests using exact procedure for calculating parameters of PID controller instead of current method of trial and errors in thermal power plant Gacko [2]. Because of comparing, there is presented auto-tuning method using ideal and saturation relay [3]. Very substantial part of paper is simulation and proposing of compensation of eventual static load disturbance. Its negative effects during auto-tuning test were overcome by applying automatic bias [4].

2 DESCRIPTION OF CONTROL SYSTEM OF LEVEL IN THE CONDENSER

In this chapter, condenser of turbine in thermal power plant Gacko will be described taking in account all its connections with other components of control system.

2.1 Object's structure

Level in condenser is determined by the amount of steam which comes from turbine (directly and from heater for regenerative heating), supply of demineralised (DEMI) water, drain of condensate and work of vacuum pumps for obtaining vacuum in condenser, as shown in Fig. 1. Control of level is performing by using two closed-loops. In the first, level control is carried out over valve for condensate drainage from the condenser, while in the second loop mentioned control is carried out using valve for DEMI water supply. Therefore, in both closed-loops within the system, the control part of the object is valve i.e. it is used damping control method [2].

The main goal is to obtain good dynamic behavior of system and keep desired level value in steady state. This set point (reference value of level) is $h_{\check{z}}$ = 1,2 m.

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