

Reduced Energy Cost through the Furnace Pressure Control in Power Plants

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Abstract:

Maintaining pressure in the boiler's furnace is one of the key requirements for proper combustion in steam boilers in thermal power plants. This paper proposes a control strategy that eliminates flap in the channel for the output gases. This is achieved by applying the frequency regulator for asynchronous motor speed control. Reference value for the frequency regulator is obtained through the PI controller. Special attention is given to tuning of PI controller. Well-tuned PI controller with the use of frequency regulator provides significant energy savings, because asynchronous motor for ventilator of steam boiler in thermal power plants has a large power. Modification of relay feedback experiment has supported λ -tuning of controller whose two types (faster and robust) were tuned. This modification consists in:

- a) Replacement of relay characteristic with saturation curve,
- b) Fourth-order process identification with first-order process plus dead time.

The methodology is illustrated by simulations.

Keywords:

Energy saving, Combustion, Frequency regulator, PI controller, λ -tuning.

1. Introduction

Steam boiler, as well as the other components of power plant, performs energy transformation. Therefore, energy dissipation, during combustion process, is present here. This paper considers and suggests possibilities for energy saving by changing in strategy of furnace pressure control as part of boiler. That means replacing of damping control with strategy which is based on frequency regulators (variable-speed drives). Namely, furnace output gases are controlled by ventilators (fans) instead by flap (valve) in output channel. The aim of this paper is to build new control loop for furnace pressure using frequency regulators for asynchronous motor speed control, which drives ventilator.

In this control system, PI (proportional – integral) controller generates reference values for frequency regulator [1]. In order to explore an adequate tuning of PI controller, the method for process identification using relay feedback test was carried out using simulation. Saturation relay will be applied instead ideal relay because of its well known advantages [1]. Unlike previous research, fourth-order process was identified as true first-order process plus relative small dead time [2]. Afterward, method of λ -tuning gives parameters of PI controller, which is adequate for first-order process. Because of the possibility of different conditions during operation of the system, two types of PI controller (faster and robust) will be tuned [1]. Their quality will be explored after simulation of entire control loop for furnace pressure and analysing of process response. Essentially, this survey tends to exploit simulation as a tool for considering improvements of existing control system. Accordingly, researches in this paper are focused on reducing the energy consumption that is neces-

