

Model Based Controller with Internal Model Control (IMC) Which Tuning by Set Point and Disturbance on Power Plant Based HYSYS

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Abstract – Waste heat recovery generation (WHRG) is a power plant systems which utilize waste gas in process of industries. To design plant of WHRG need right control parameters for maintain heat and mass balance. The control technique of PID is the methode usually used in all industries by doing tuning based of changes set point changes. In fact, not only based on the change of set point tuning can generate proper response, but the value based on disturbance change of tuning is also appropriate for used. This is due to value based on tuning disturbance can reduce the nuisance value of direct entry at the output of the process. The tuning of the set point value is given i.e. $\pm 5\%$, $\pm 10\%$ and $\pm 15\%$ of the design data are used, whereas for tuning of disturbance value that is used i.e., $\pm 5\%$ of the value of the input parameter used as a disturbance. Based on the resulting control response indicates that the method for use to control the tuning disturbance in this research, it is not appropriate to be applied using methods of IMC-PID. This is due to the characteristics of the resulting response indicates a value that is less good.

Keyword : Waste Heat Stem Generator (WHRG), Tuning, Set Point, Disturbance, IMC-PID.

INTRODUCTION

At this point, the electrical energy consumption in Indonesian increased every years. Not only in Indonesia, the level of electricity consumption across the world were increased too. Based on studies conducted in Badan Koordinasi Energi Nasional (Bakoren), which estimates that demand for electricity in Indonesia increased by 3.4% per year and totaled approximately 8146 petajoules (PJ) in 2025 (Bakoren, 2010). This is because as many sources of electricity which comes renewable energy, such as solar power, wind power, water-flow biological processes, and geothermal untapped optimally (US National Energy Laboratory Renewable, 2012). Because the needed of electrical energy is on the rise in every year, it can cause a power outage cycle through which many complain about by the publics (Kompas, 21 July 2012).

One of the step to reduce these problems is by creating electrical energy sources independently. The

independently of electric energy sources can obtained from the using exhaust gas that is present on a wide range of industries, and the exhaust gas still have a high thermal value for use as a steam power plant system (Umamaheswari, 2013). Utilization of exhaust gas as an energy source steam power was called WHRG (Waste heat recovery generation). The WHRG is an electricity generation system utilizing exhaust gas from a chemical process, so this much of power system used in the chemical industry.

IMC-PID control techniques are applied to power plant with tuning the changes of set point. In fact, not only based on tuning set point changes can generate the proper response, but the value based on disturbance tuning is also appropriate for use. On the disturbance tuning can reduce the nuisance value of direct to entry at the output of a process (Biyanto, 2013). There are two kinds of provisions in order to make a precise tuning, i.e. the first such control systems including servo into the problem or regulatory problems, and the second is using control algorithms or tuning usually use internal control. On the last research previously done by Asana Kusnadi with the subject design of controller and response analysis using Internal Model Control (IMC) has carried out the controls on power plant aims to produce a response in accordance with the set point and reduce the level of disruption that go directly at the output of the process. However, this only applied to the unit operation Heat Exchanger only. Therefore, in this research will be designed a model based analysis of controller by using internal model control (IMC) which tuning based on set point change and disturbance change on the power plant based HYSYS software.

RESEARCH METHODOLOGY

To achieve the objectives that have been set, the required methodology as stages that must be done in completing this final task. As for the methodology:

A. Modeling and validation of data

To design a model waste heat recovery generation system with using HYSYS software, then the necessary datas that will used, i.e. the form of the composition, temperature, pressure, and the mass flow rate in each stream will be used. On the design of WHRGS there are

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two kinds of input values, i.e. the flue gas to be used as heating and feed water in which will be turned into steam.

B. Test of design power plant

After the necessary data is obtained, then the first step is to do design of WHRGS with HYSYS software. Design systems used i.e. There are two kinds, the first is the design of steady state and the second is a dynamic design. Design of steady state function to simulate the processes that exist in design, but this does not change the design to changes in time. While the dynamic design is a design depicting a real model, this is because the design is constantly changing – change of function of time. In this dynamic design that serves as a controller required guards to defend the value of the calculation of the heat and mass balance. The operation of unit will be used i.e. There are 4 kinds, namely heat exchanger, steam drum, pumps, and turbine. The four operating units will be simulated in software HYSYS 7.3 obtained in the file HYSYS (*. hsc).

C. Tuning set point and disturbance

The design of waste heat recovery generation system control parameters to note that on the unit operation vessel. This is because the value of inputs and outputs on this unit operation is always changing change of time function. On this vessel operating unit there are three kinds of control parameters are used, i.e. FIC-100, P-100, and LIC-100. The third type of mounting the control parameter because the value of inputs and outputs on the unit operation vessel is always changing – change of time function. The procedure is done to make changes based on the current set point of tuning on the design WHRGS is the following:

- a. Open loop data retrieval
- b. Define controll parameter
- c. Determine kC, Ti, and Td based on IMC-PID table.

D. Perform test based on set point and disturbance tuning

A test based on value set point and disturbance tuning are important to do, this is due to both the tuning with testing we can know that based on the value of Kc, Ti, and Td has been granted can change the response of the process variable (PV) that have been produced. A good-value can be said to tuning in the tuning given can produce a response process variables follow value has been set. But instead, a value can be said to tuning is no good if the value of tuning that was given was unable to produce a response process variables.

RESULTS AND DISCUSSION

In this chapter will be done testing and data analysis modeling system on waste heat recovery generation system. The first test will be carried out, namely the determination type of mounting the controller which will be used for the model plant. In addition, there are two

kinds of model plant trials using HYSYS software, which changes the set point and the disturbance.

A. Determine controller type that used in design of waste heat recovery generator system.

The need for this controller can be seen from the response of each stream is provided. If the value of the response stream that is generated is always changing – the change of time function to the given design data, then in the stream must be paired with a controller that serves to maintain the value of heat and mass balance. Figure 1 show controller on steam drum.

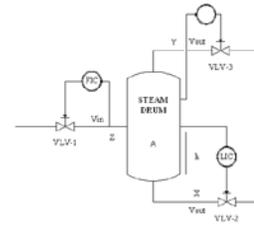


Figure 1. Control structure on steam drum.

B. Test open loop based on set point and disturbance

The third type of controller in HYSYS software demonstrated by FIC -100, PIC-100, and LIC-100. For know the stability controller is required tuning to accelerate the desired steady response, as well as reduce the incidence of error. Therefore, the required value of tuning Kp, Ti, Td and the right to achieve both these things.

C. Test close loop WHRG plant based on set point and disturbance.

The close loop testing is the method tested of the value of the parameter being performed upon installation of the value given in the controller WHRG plant. The usefulness of this close loop test is to know the resulting system response based on the parameters of the given control. On the simulation of the plant there are two kinds of WHRG values test close the loop, the first is a test based on the value of the change set point and the second is the value to test against changes to disturbance.

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