© 2015 IJSRSET | Volume 1 | Issue 6 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

On Using Fuzzy Logic Controller in Determination and Performance of Industrial Boiler

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ABSTRACT

This paper focus on the performance of an industrial boiler using fuzzy logic controller. The parameter of the various industrial boilers is subjected to the change due to change in the environment or atmosphere. This parameter may be categorized as steam, pressure and temperature of the industrial boiler in use. In this paper work, a strategy of fuzzy logic controller called fuzzy supervisory is used which generates set points for the conventional controllers. This work also compared the performance of a boiler evaporator system when the system is controlled by a traditional proportional integral derivatives type strategy and when the system is controlled using fuzzy logic blocs to provide set point for it. The main change consists of representing only the behavior of the drum evaporator system having a partial model of the combustion process with a simplified combustion control system and a three element boiler feed water receives a supervisory signal that comes from fuzzy logic to improve the performance of the overall control system.

Keywords : Steam Drum Fundamentals, PID Controller

I. INTRODUCTION

Fuzzy Logic has demonstrated well in its broad potentials in industrial automation application in recent years. Traditional system modeling and analysis techniques are two specific for such problems and in order to make complexity, less discouraging, we introduce appropriate simple method to achieve a satisfactory compromise between information we have and the amount of uncertainty we are willing to accept [1].

Fuzzy logic theories are similar to other engineering theories because almost all of them characterize the real world in an approximate manner. The fuzzy logic tool was formerly introduced in 1965 by Lotfi Zadeh and is a mathematical tool for dealing with uncertainty. As uncertainty increases so does the complexity of the problem increases which it offers a soft computing partnership, the important concept of computing with words and this provides a technique to deal with imprecision and information granularity. Boilers play important roles in power generation units and its control is very critical in many application and proportional integral derivatives control is being implemented for this purpose. Conventional controllers in power plants are not very stable when there are fluctuations and in particular emergency characterized by non-linearity, uncertainty and load disturbance. The characteristics of a power plant system change significantly between heavy light loading conditions. [2] Application of traditional control methods encounter great difficulties while the process working condition changes within a large operation and to many studied control methods like expert systems fuzzy logic control, neural networks and knowledge based system. Traditionally, accurate mathematical model based strategies have been applied to deal with control problems. But however water level control system is very complex system because of the non-linearism and uncertainties of the system. Fuzzy logic and neural networks control have emerged over the years and becomes some of the most active and fruitful areas of the research in the intelligent control application. The two major types of control rules in fuzzy control are the mamdani rule that deals significantly more linguistically intuitive and sugeno rules that appears to have more interpolation power even for a relative small number of control rule. In neural network, the most commonly used are supervised control, direct inverse and neural adaptive control [3].

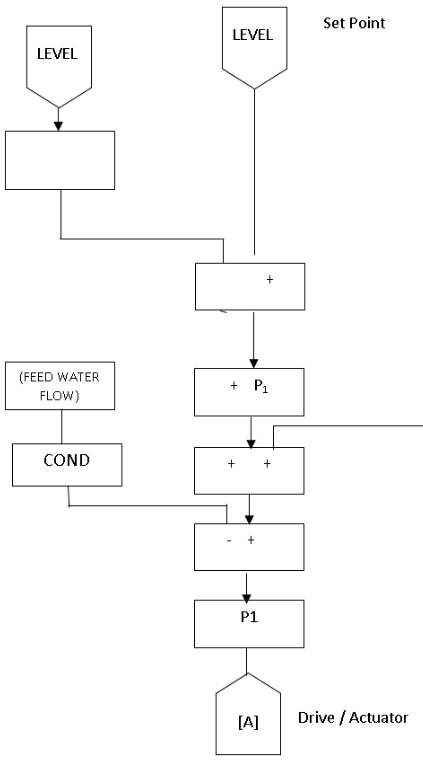

Figure 1: Shows the Drum Level Three Element Controller

II. METHODS AND MATERIAL

A. Data Connection

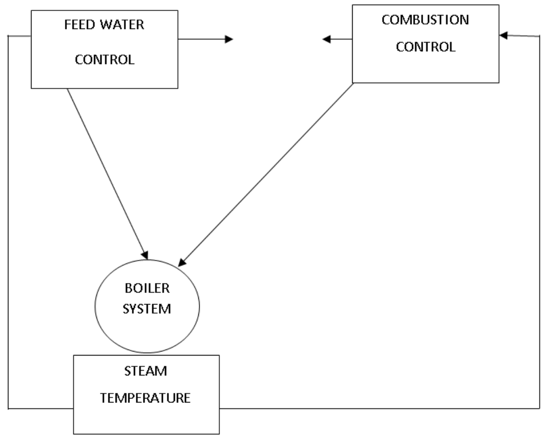

Figure 2 : Black Diagram of Data Collection

Fig 2 shows block diagram of data connection. The data were obtained from the boiler system. The boiler system element is built inside the boiler system and other special software that is incorporated into counter situated at the combustion control system. These control functions are firing demand (combustion control), steam temperature and feed water. In general, the firing demand control adjusts the amount of fuel fired in the boiler. Steam temperature controllers manipulate the temperature of the steam output through the use of desuperheated of attemperators. Feed water controllers modulate the amount of water in the boiler system. It is important to note that while there are three distance control systems mentioned here, in actual practice they are very interrelated. Improper adjustment of the feed water entering the system can significantly affect the combustion control and the steam temperature control which will in turn affect overall boiler efficiency. For this simple reason, it is desirable to turn these loops so they have minimal interaction with each other. Most boiler system contains a de-aerating tank which removes dissolved gases from the feed water. The de-aerating tank is the source of feed water to the pumps. Because feed water de-aerating is achieved through boiling, the water leaving the tank may be very close to the boiling point. It would be undesirable for the water at the pump section to flash to steam, so the de-aerating tank is located at an elevation above the feed water pump. This elevation should be chosen in order to guarantee enough pressure at the pump suction to prevent flashing. The water pressure at the pump suction is called net positive. Suction head (NPSH). Recirculation lines are installed in the system for pump protection and because a significant amount of heat is generated by the pump, it is desirable to maintain at least 15-20% flow through the pump at all time. This flow serves to carry the heat away from the pump and prevent overheating. Also check valves are installed in the systems requiring more than one feed pump of the feed water pump leads to the steam drum.

III. RESULTS AND DISCUSSION

A. Data Presentation and Analysis

The measurement of data collected which include time, observed measurement, simulated and error are presented in table 1.

Time (minutes)	Observed measurement(m)	Simulated m	Error
90	26.0	26.0	0.0
95	27.0	27.1	0.1
10	25.0	25.1	0.1
105	26.1	26.2	0.1
110	26.1	26.0	0.0
115	26.1	26.0	0.1
120	26	26.3	0.1
125	25.8	25.6	-0.2
130	24.2	24.1	-0.1

Table 2: Component Parts and Descriptions of Typical Boiler

Part	Component	Function
1	Self-acting temperature controller	To control the water tank water temperature
2	Strainer	To protect the self-acting control valve form detritus
3	Self-acting control valve	To control the steam flow to the injector
4	Vacuum breaker	To prevent water back siphoning into the steam supply
5	Electric actuator	To actuate the makeup water value
6	Make up water control valve	To control the makeup water up water to the feed back
7	Vent Head	To prevent high velocity discharge from the tank vent
8	Automatic air Vent	To vent air from the desecration head
9	PID Controller	To control the water level in the tank
10	Level Control sensor	To sense the level of water in the tank.

IV. CONCLUSION

In this paper the various causes of industrial malfunctioning has been identified. It was observed that the main concern about the fuzzy logic controller is the problem obtained in the numerical solution, which means that the equation system is conditioned and numerical instability. The behaviour of the supervisory controller has an advantage for the system performance compared with traditional three element level and steam pressure controller.

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