

# "A Case Study of Three Drum Parameter Control in Boiler Using Discrete PID Controller Based on Simulation"

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**Abstract:** In the global world, the energy demand increases in a broad level to solve the demand of energy supply. In this field a research program working in a broad level by scientist or knowledgeable engineers. In This methodology of Unified controls for a Power plant is conceived by the consultants and discrete PID contractor to improve the plant efficiency. This is implemented in few projects and various options are also indicated in the methodology. In this paper an attempt has been made to design discrete PID controller for drum parameter control. In the initial stage used in a Boiler by use MATLAB. Comparison of discrete PID controller with conventional controller is also discussed in this paper.

**Keyword:** Proportional-integral-derivative Controller, Control Algorithm, Conventional Controller.

## 1. INTRODUCTION

In the modern era the world population increases day to day for solve the electricity issue, increases a new generation power plant. In the modern world a human beings can't a live without electricity. With the help of electricity's we feel our life easier and comfortable.

In all over the world Country increases our energy power and comes on the top in the developing nation. In this paper problem is reduced with controller of boiler. As like as water flow, heat flow, temperature control & Recycle of energy.

We know that in Boiler the back bone of plant. we can't imagine without boiler, because the boiler is the life line of the generating power plant.

Boiler is very costly instrument so we must careful about her safety. In boiler configuration is very complicated, in this paper to reduce the problem and developed a new model in boiler using discrete PID controller. A PID controller controls the three elements as like as heat flow, water level and steam flow. In this paper to calculate and solve the time taken problems for boiler and also provide an efficient result and Improve plant efficiency.

### 1.1 Need for boiler Automation

Boiler is the back bone of any generating power plant, it requires continuous monitoring and inspection at frequent interval. In plant it has Number of boiler section, this boiler section produce the high temperature pressure. In a boiler steam temperature in thermal power plant is very complex and couldn't easy to control. Due to poorly understanding they have dangerous loss. It's is critical for the safe operation of the boiler and steam turbine. In this paper to solve this type of problem. Various controlling mechanism are used to control the boiler system so that it work properly, many control strategies have been applied to it.

### 1.2 Working Principle:-

Both oil and gas fired in boilers use controlled combustion of the fuel to heat water. The key boiler components involved in this process are the burner, combustion chamber, heat exchanger, and controls. The burner mixes the fuel and oxygen together and, with the assistance of an ignition device, provides a platform for combustion. This combustion takes place in the combustion chamber, and the heat that generates & transferred to the water through the heat exchanger. Controls regulate the ignition, burner firing rate, fuel supply, air supply, exhaust draft, water temperature, steam pressure, and boiler pressure.

Hot water produced by a boiler is pumped through pipes and delivered to equipment throughout the building, which can include hot water coils in air handling units, service hot water heating equipment, and terminal units. Steam boilers produce steam that flows through pipes from areas of high pressure to areas of low pressure. Steam utilized for heating can be directly utilized by steam using equipment or can provide heat through a heat exchanger that supplies hot water to the equipment.

### 1.3 Steam Boiler Efficiency:-

The percentage of total heat exported by outlet steam in the total heat supplied by the fuel (coal) is called steam boiler Efficiency. Includes with thermal Efficiency, Combustion Efficiency & fuel to steam efficiency. Steam boiler efficiency depends upon the size of boiler uses. A typical efficiency of steam boiler is 80% to 88%. Due to some losses occur like incomplete combustion, radiating loss occurs from steam boiler surrounding wall, defective combustion gas etc. Hence, efficiency of steam boiler gives this result.

### 1.4 Introduction to boiler:-

A boiler is an enclosed vessel that provides a means for

combustion and transfer heat to water until it becomes or steam. The hot water or steam under pressure is then usable for transferring the heat a process.

Water is useful and cheap medium for transferring heat to a process. When water heat to a process. Water is boiled into steam its volume increase about 1,600 times, producing a force that almost as explosive as gun power. This causes the boiler to be extremely being treated carefully. Liquid when heated up to the gaseous state this process is called evaporation. The heating surface is any part of the boiler. Hot gases of combustion are on one side any water on the other. Any part of the boiler metal that actually contributes to making steam is heating surface of a boiler is expressed in square a meters. The larges the heating surface a boiler has, the more efficient it becomes.

Boiler system is made up of

- (a)Feed Water flow
- (b)Steam flow
- (c)Fuel flow

**1.5 Element Strategy:-**

As shown given below (simulation), most boilers medium to high pressure today use a “three element control” boiler control strategy. The term “three-element control” refers to the number of process variables (PVs) that are measured to effect control of the boiler feed water control valve. These measured PVs are

- Liquid level in the boiler drum,
- Flow of feed water to the boiler drum, and

- Flow of steam leaving the boiler drum.

**1.6 PID CONTROLLER:-**

A proportional-integral-derivative controller is a control loop feedback mechanism (controller) widely used in industrial control systems. A PID controller calculates an error value as the difference between a measured process variable and a desired set point. The PID controller algorithm involves three separate constant parameters, and is accordingly sometimes called three element controls. The proportional, the integral and derivative values, denoted P, I, and D. Simply put, these values can be interpreted in terms of time: P depends on the present error, I on the accumulation of past errors, and D is a prediction of future errors, based on current rate of change. The weighted sum of these three actions is used to adjust the process via a control element such as the position of a control valve,

**1.7 Tuning of ideal discrete PID Controller Terms:-**

The P, I and D terms need to be "tuned" to suit the dynamics of the process being controlled. Any of the terms described above can cause the process to be unstable, or very slow to control, if not correctly set. These days temperature control using digital PID controllers have automatic auto-tune functions. During auto-tune period the PID controller controls the power to the process and measures the rate of change, overshoot and response time of the plant. This is often based on the Zeigler-Nichols method of calculating controller term values. Once the auto-tune period is completed the P, I &D values are stored and used by the PID controller.

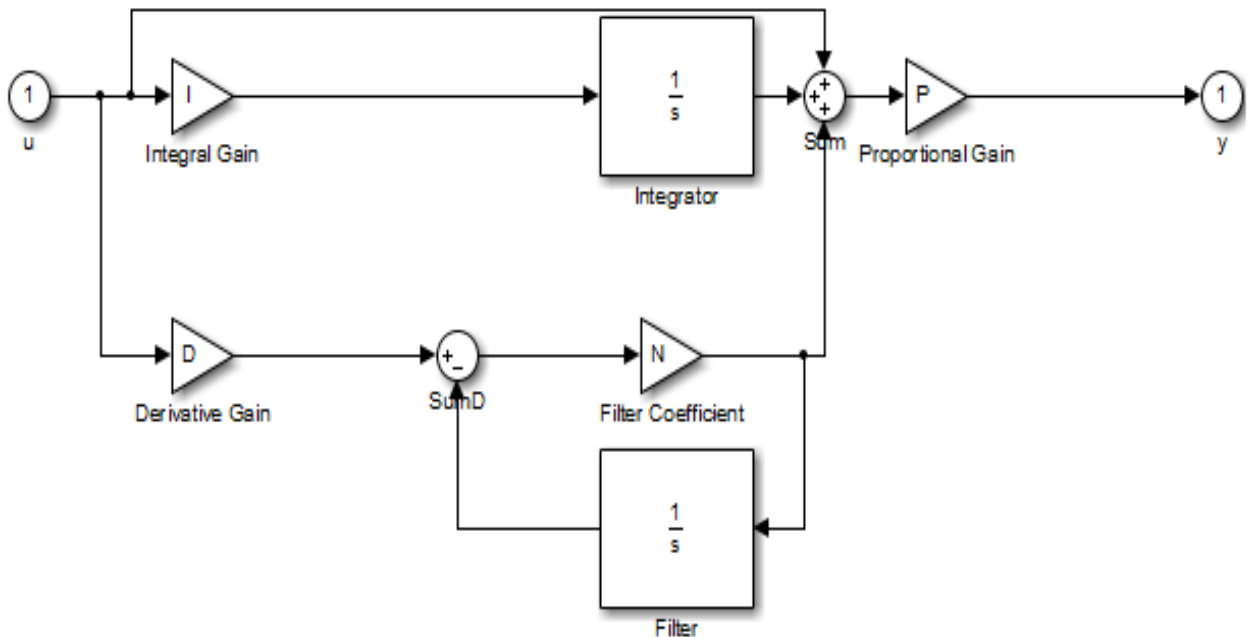


Fig.1.7 A tuned ideal block diagram of discrete PID controller

**2. Simulation with PID controller (step input):-**

We will see the responses by apply first step input and

ramp input, block diagram, simulation is given below, which step input is applied.

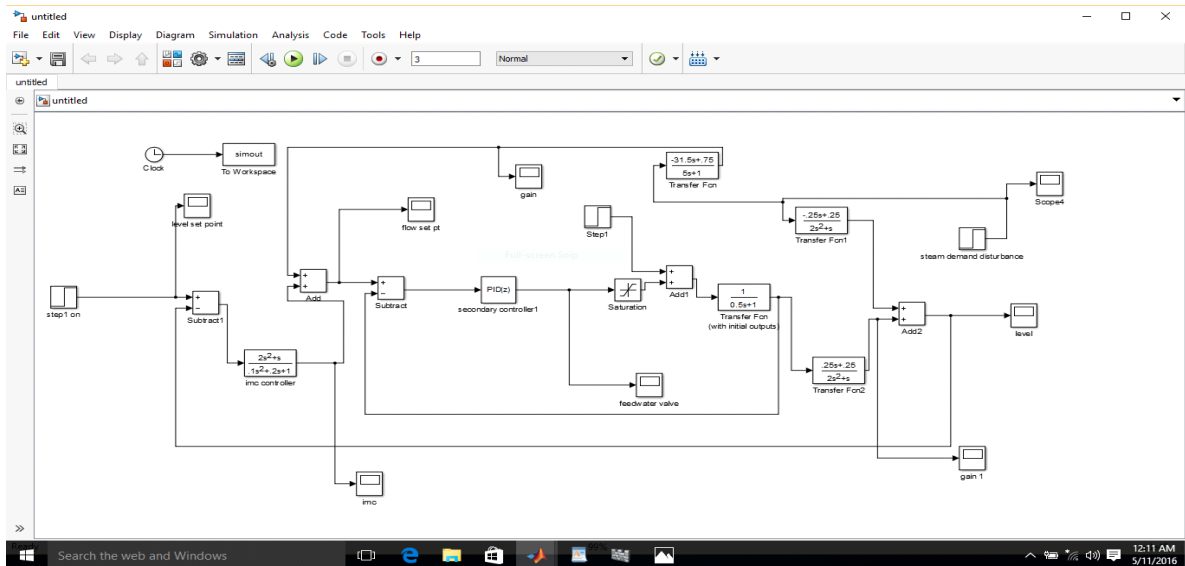


Fig.2.1 simulation Block diagram of PID controller

### Step input



Fig.2.2 A Block Diagram Step input Response

It show step input response which is set point level of Boiler. Also the output of PID controller is given further. in the given scope at step parameter initial point is taken as 0, and final value is 1 which is set point.

### Feed water level

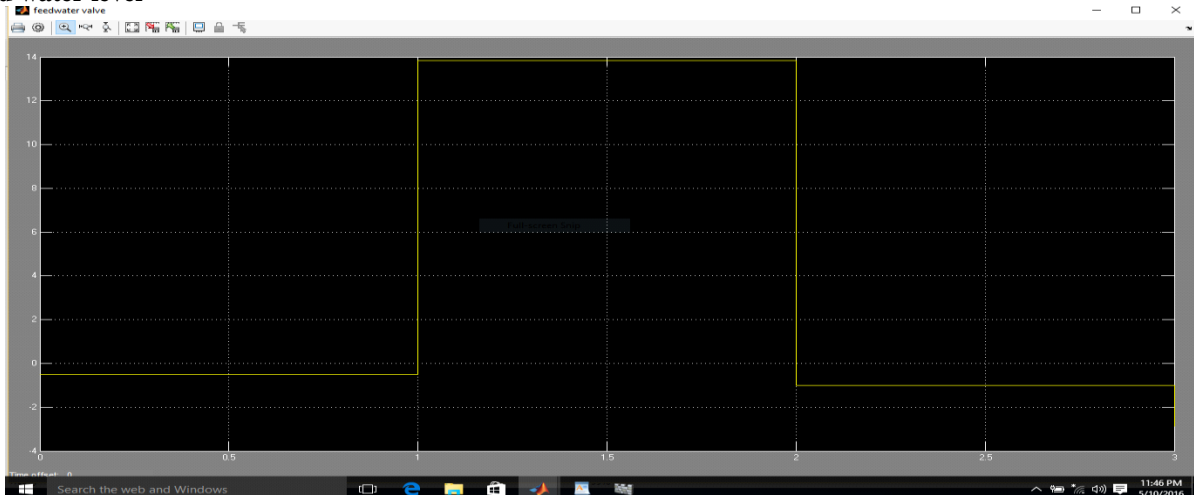


Fig.2.3PID controller response with step in put

It shows the response of the PID controller output

### Flow set point

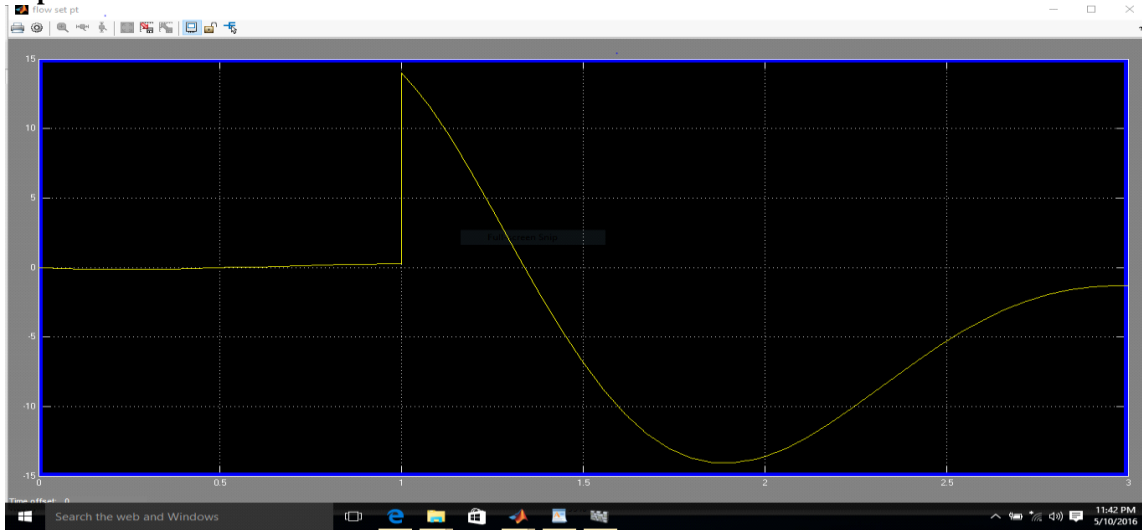


Fig.2.4 A Block Diagram Represent ramp output

### IMC controller

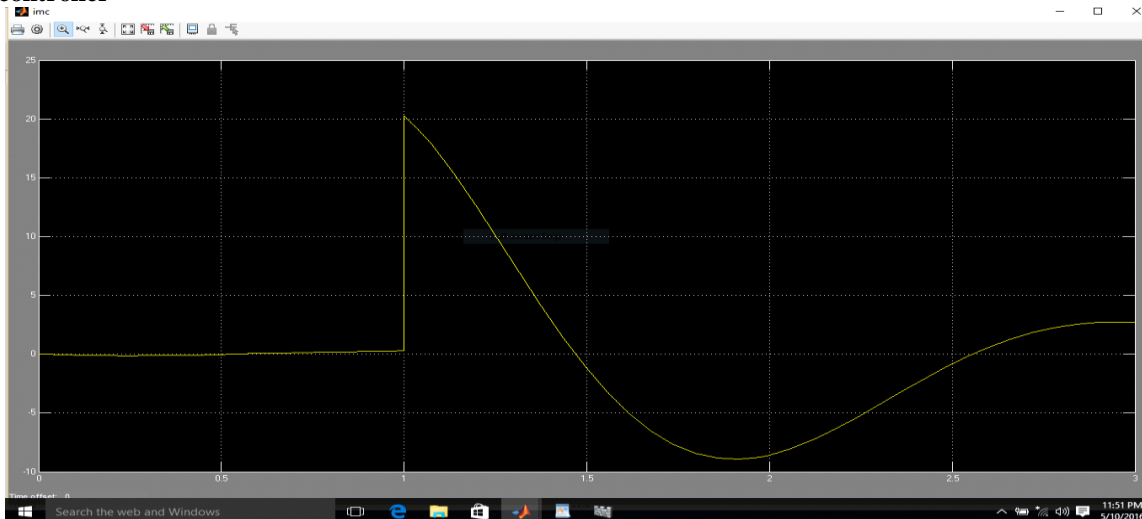


fig.2.5 A Block Diagram of flow set point

### water flow level

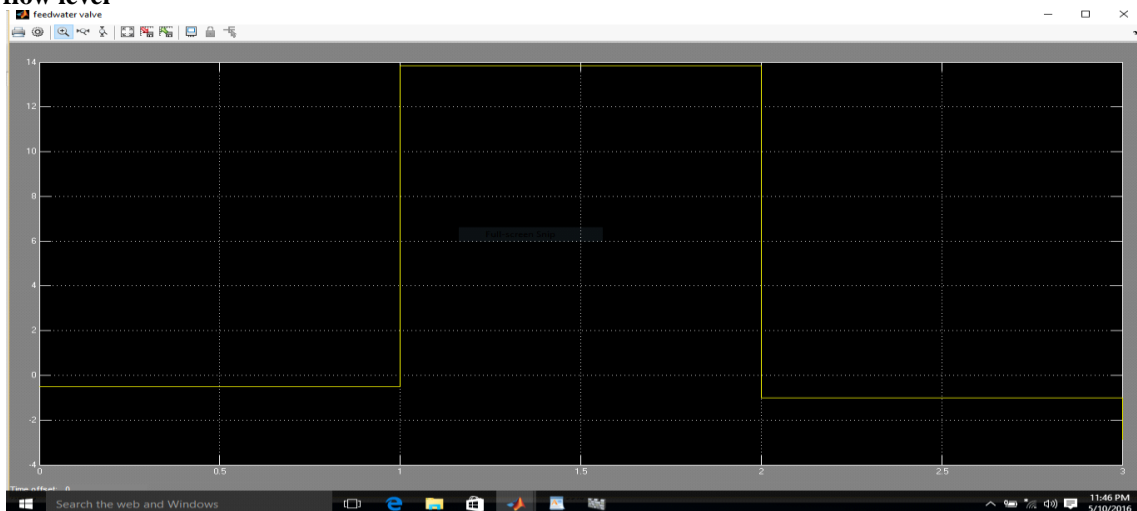


Fig.2.6 A scope representation on Water flow valve

**Level output in scope**

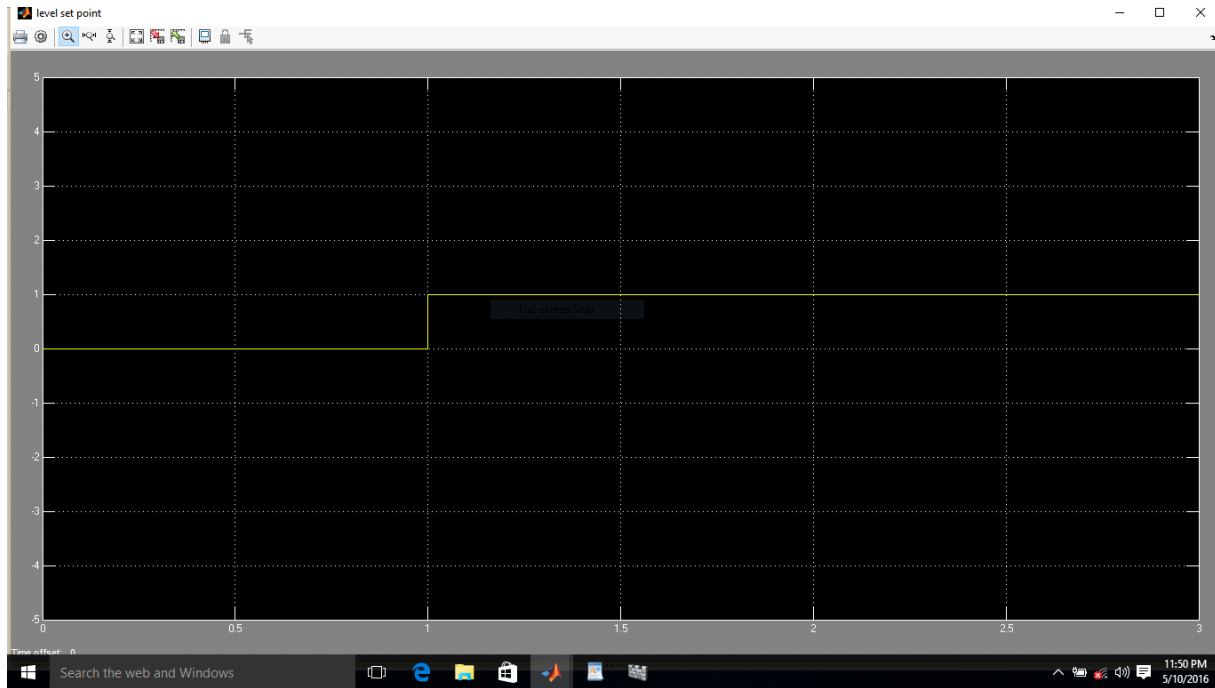


Fig.2.7 A block diagram of level output in scope

**3. RESULTS & DISCUSSIONS**

The result response of the controller we have taken for analysis, using simulation process. We have discuss in previously the simulations block diagram are implemented in MATLAB using discrete PID controller. These work as secondary controller we taken as IMC controller these controllers have different response for the input taken as unit step and ramp. After simulation we have find that theseentire controller have different value of parameter such as peck time, settling time, and rise time, maximum overshoot steady state error. In the analysis we have seen the more accurate result come using discrete PID controller. We have only SISO (single input single output), with these systems, we have only one variable to control and only one action to apply. In this project using discrete PID controller to improve the drum level parameter performance in boiler. Easy to control the drum parameter as like as temperature, heat flow and water flow level.

**4. CONCLUSION AND SUMMARY**

The use of discrete PID controller improves the performance to great extent. Discrete PID controller shows better performance. We can say that for the nonlinear plant or when the plant response is changes with time, or there is uncertainty we should use PID controller. For the disturbance to occur it should be also taken into account, it can be easily remove and the system given better response using discrete PID controller. Discrete PID controller can adjust the control action before a change in the output set point actually occurs. This parameter variation of normal and abnormal condition is represented in resulted output scope.

The discrete PID controller improve the performance of drum parameter, it is much important then Continuous and another controller. The paper help us to improve the efficiency of the plant.

**REFERENCES**

- [1] Raj Kumar “Boiler drum level control by using wide open control with three element control system” International Monthly Refereed Journal of Research In Management & Technology 2013.
- [2] Anise Mathew” Internal Model Control of pressure process using ARM Microcontroller” International Conference Computing, Electronics and Electrical Technologies (ICCEET), 2013
- [3] Gowrie Shankar “Control of Boiler Operation using PLC – SCADA” International Multi Conference of Engineers and Computer Scientists (IMEC), 2008
- [4] Hari Krishnan “optimization of main boiler parameters using soft computing techniques “International Journal of Research And Technology.
- [5] Rahul Malhotra “Boiler Flow Control Using PID and Fuzzy Logic Controller” International Journal of Computer Science & Engineering Technology (IJCSET), 2011.
- [6] Roopal Agrawal, Umesh C.Pati “Internet Based Boiler Drum Level Control System Using LabVIEW”
- [7] Sanjoy Kumar Chakraborty, Nilotpal Manna and Surodh Dey” Importance of three-elements boiler drum level control and it installation in power plant” International Journal of Instrumentation and Control Systems (IJICS), 2014.
- [8] Saurav kumar “Multi parameter monitoring & controlling for a boiler using pic controller” International Journal of Scientific & Engineering Research, 2014.
- [9] Shital S. Chopade, Pradhuman Verma, Prashant Versa” Simulation of Boiler Control using PLC & SCADA” International Journal of Engineering and Advanced Technology (IJEAT), 2013.
- [10] Subodh Panda ,Bikash Swain ,Sandeep Mishra “Boiler Performance Optimization Using Process Neural Network”I ndian journal of applied research paper, 2013.

**BIOGRAPHY**

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