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TITLE: EVALUATION OF VARIOUS TUNING RULES FOR TUNING OF TEMPERATURE PROCESS CONTROL

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ABSTRACT

Proportional, integral, and derivative (PID) controllers are the most used in the chemical process industries because they are straightforward to implement and achieve desirable results. A PID controller can be used for the regulation of speed, temperature, flow, pressure, and other process variables. The open loop is being run to verify the most effective tangential technique for the process control loop. Ziegler-Nichols, Cohen-Coon, and the Takahashi approach are just a few of the tuning criteria employed in this process. The research main objective is to determine through comparison, the optimal tuning rule for achieving the specified level of control performance. The comparison has been made using the criterion of settling time and the integral of the absolute value of the error (IAE).

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CHAPTER ONE
BACKGROUND

1.1 Introduction

Tuning in process control refers to the process of adjusting the parameters of a control system to optimize its performance. This is typically done by adjusting the proportional, integral, and derivative gains of a proportional-integral-derivative (PID) controller, which is the most common type of controller used in industrial process control. The tuning process involves measuring the performance of the control system and adjusting the gains until the desired level of performance is achieved. There are different methods for tuning a control system, such as the Ziegler-Nichols method, the Cohen-Coon method and the Takahashi method. Most PI and PID controllers may be tuned using the Ziegler-Nichols approach. In 1942, John G. Ziegler and Nathaniel B. Nichols made the initial suggestion. Utilizing the gain and oscillation period to determine the controller's settings, the approach includes gradually raising the controller's gain until the system displays persistent oscillations. Although the Ziegler-Nichols approach is straightforward to use, it may result in a less reliable controller than one created using more advanced ways. The Takahashi tuning rule is a method for tuning PI controllers in feedback control systems. It was first proposed by T. Takahashi in 1991. The method uses the process time constant, and process gain to determine the controller's parameters. Specifically, the controller's integral time constant is set to 0.5 times the process time constant, and the controller's proportional gain is set to 2 times the process gain. This method is known to work well for systems with moderate to slow dynamics, but not as well for faster system {Takahashi, T. 1991}. The Cohen-Coon method is a tuning method for PID controllers that is based on the process dynamics. It was first proposed by Cohen and Coon in 1957. The method involves first determining the process time constant and the process deadtime. Using this information, the controller's parameters are then set according to a set of rules that take into account the relative importance of the proportional, integral, and derivative modes of control for the specific process. The Cohen-Coon method is widely used and is considered to be one of the most effective methods for tuning PID controllers, especially for processes with moderate to slow dynamics

Over the years, there are many formulas derived to tune the PID controller for adjusted parameters and achieved optimum value. There are three parameters must be tuning to achieved optimum value.

SYMBOL	PARAMETER
PB	Proportional
T_I	Integral
T_D	Derivative

1.2 Literature Review

LR subtopic 1

The control parameters of a control system, such as gain, integral time, and derivative time, are determined by tuning rules, which are mathematical formulas or guidelines. These guidelines are meant to serve as a jumping off point for the optimization of control parameter, saving time and effort during the tuning procedure. There are several commonly used tuning rules. First tunning rule is Ziegler–Nichols. Ziegler-Nichols tuning method is a rule-based tuning method that uses the process's step response to determine the control parameters of a PID (proportional-integral-derivative) control system. It is one of the simplest and most widely used tuning methods in process control. An efficient and straightforward method for choosing the control parameters for a PID control system is the Ziegler-Nichols tuning method. It should be mentioned that the procedure might not always produce the best results and that more sophisticated tuning techniques might be needed for intricate processes. Next is Cohen-coon tuning rule. Cohen-Coon tuning method is a rule-based tuning method that considers the process response to a step change in the setpoint. It is used to determine the control parameters of a PID system. Lastly is Takahashi tuning rule method. The Takahashi tuning method is a rule-based tuning approach that leverages the frequency response of the process to pinpoint the PID (proportional-integral-derivative) control system's control parameters. It is one of the most popular and