

Application of Lookup Table Technique with PID Controller for Fast Flow Ratio Response

P. Klaynil, P. Pannil, A. Chaikla, P. Julseewong and K. Tirasesth

Faculty of Engineering King Mongkut's Institute of Technology Ladkrabang,
3 Moo 2, Ladkrabang, Bangkok 10520, Thailand
(Tel: 66-2-326-7346-7; Fax: 66-2-326-7346-7 Ext. 103; E-mail: kjprasit@kmitl.ac.th)

Abstract

The flow ratio in the industrial process is usually accomplished by using PID controller with series type ratio. But always the large overshoot and a long rise time may be achieved from this conventional control. These problems are involved to the inexact flow ratio control. In order to avoid this poor performance, the paper presents a designing of the two controller modes for the flow ratio plants. This proposed controller combine the lookup table technique and the well-known PID controller to obtain the fast response and low overshoot of flow ratio control. The PID controller mode will be operated when the flow ratio reaches the preset value while the lookup table technique mode is applied for initial operation. The data in the table is calculated by the valve sizing equation and converted to the valve position control signal. The experimental results show that the transient and steady state responses of the control systems using the proposed technique can be efficiently obtained when compared with the conventional controller.

control types are usually accomplished by using the PID controller (PI control mode) [2]. However, the used of PID controller in the real practice still require trial and error adjustment and needs the operator experiences to obtain the best response. Additionally, the large overshoot and the long rise time may be achieved from this conventional control [3]. This result is one of the problems to maintain of a fixed flow ratio.

To solve above problem, the lookup table technique is proposed in combination with the PID controller (PI control mode) for fast and precise flow ratio control. When the sample error between the independent flow input and actual dependent flow is larger than a preset value, the flow ratio control system will be operated by the lookup table technique. The PI control is employed to replace the lookup table technique when the sampled of flow ratio error reaches the preset value. This technique can maintain flow rate in the correct ratio during both transient and steady state operations.

1. Introduction

The fluid flow ratio control system is one the importance process that usually found in the industrial plants. Nowadays, there are two popular type of this control system as the parallel and series type [1] as shown in Fig. 1.

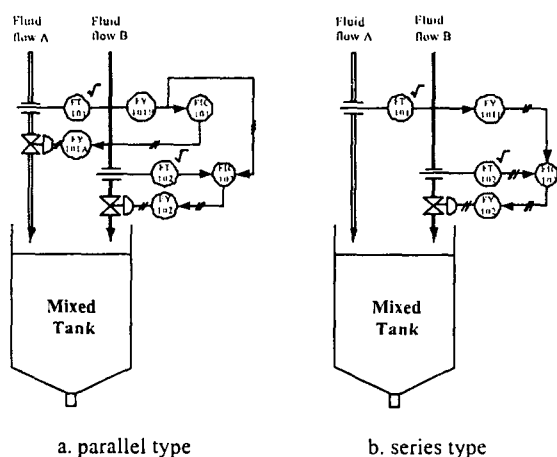


Fig. 1. The popular type of flow ratio control.

For the parallel type, the high efficiency control can be obtained because the fluid flows are independently controlled to keep the desired setpoint (little change). But this control type has high inventory. Thus the series type is still popular than the parallel type due to the lower cost inventory. In the industries, the both

2. System Operation Principles

Block diagram of the proposed PI flow ratio control with lookup table technique is illustrated in Fig. 2. A control valve is employed to control the flow of fluid B at the desired ratio. The flow transmitters are used to measure the flows of both fluids. Fluid flow A that is the setpoint of the system and fluid flow B are represented by sp and pv_2 , respectively. The signals of both control modes are employed to control the flow ratio according to the flow ratio error ($sp - pv_2$).

In Fig. 2, when the flow ratio error is larger than the preset value ($|sp - pv_2| > \epsilon$) the systems will be operated in lookup table technique mode. For this mode, the sp value is used to index the data in table. The data are the percent open of valve at the each setpoints. When $(sp - pv_2) > \epsilon$ is detected, the control valve is commanded to open quickly towards the desired position. While in case of $(pv_2 - sp) > \epsilon$, the control valve is commanded to close quickly towards the precise position. Another hand, when flow ratio error reaches the preset value ($\epsilon = \pm 5\%$ is applied in this paper), the PI control mode becomes active. The final control signal of lookup table control mode is used for the initial value or initial output signal of the PID controller. Both control signal of the system are the standard signal 1-5 Vdc. In the PI control operation, the precise flow ratio control can be achieved. Using this technique, the better system performance is obtained when compared with the system using the PI control only. The system operation flowchart is shown in Fig. 3.