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Development of the Gas Mixer with Proportional Mixing Ratio

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Abstract. An actual gas mixer features that a single gas outlet pressure will be raised if the mixed gas output flow is smaller than the single gas output flow when mixing takes place, and if it is raised to the operating limit of flow regulator, some part of the total flow of mixed gas output will be decreased, and the flow will be decreased from the smallest input pressure among gas elements of the mixed gas. This feature causes errors in mixing proportion.

Keywords: gas mixer, proportional mixing ratio, Mass Flow Control

1 Introduction

The application of gas mixing is widely spread in overall industry fields including steel casting, pulp bleaching, microorganism cultivation, etching process of semiconductor, refrigerant for household appliance, and food packaging. It may safely be said that the control of mixing concentration and accuracy is an essential technology for national industries.

However, in mixing gases, many accidents occur in succession recently in gas-related areas because of the proliferation of deterioration of equipment and safety ignorance.

Therefore, our company developed the technology of controlling mixing proportion, automatic switch, and non-electric gas supply systems, to have the gas mixing system as follows.

An actual gas mixer features that a single gas outlet pressure will be raised if the mixed gas output flow is smaller than the single gas output flow when mixing takes place, and if it is raised to the operating limit of flow regulator, some part of the total flow of mixed gas output will be decreased, and the flow will be decreased from the smallest input pressure among gas elements of the mixed gas. This feature causes errors in mixing proportion.

In this study, mixing concentration would be measured according to the function of proportional mixing ratio control as the pressure difference of inlet and outlet (P) of balance and ingredient gases were changed into 3 cases. Also, reproducibility of this facility, accuracy of mixing concentration, and accuracy of calculation concentration will be measured, so that this study may be help for studies of the future developers.

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1.1 Experiment Methods

Experiment facility is SHGM-MX of our company (Sehwa High Tech Co., Ltd.), and its photographs and overall schematic diagrams are described in Fig 1.

Mixing proportion control algorithm was produced by using Labview as in Fig 2. Flux can smoothly flow when the pressure difference between inlet and outlet(P) is over 0.5 bar due to the characteristics of MFC (Mass Flow Controller).

In the experiment, the inlet pressure of balance gas and ingredient gas were established as 3 cases (hereinafter Case 1: SF6 = 3bar, N2 = 3bar / Case 2: SF6 = 4bar, N2 = 3bar / Case 3: SF6 = 3bar, N2 = 4bar), and the mixing concentration ratio of balance gas and ingredient gas was measured depending on the function of correction function, as the outlet pressures were changed.

The experiment was conducted as outlet pressure was being adjusted in the interval of about 0.5 bar from 0 to 3 (4 bar for Case 3) using Back Pressure Regulator in the condition that inlet pressures of balance gas (hereinafter N2) and ingredient gas (hereinafter SF6) were maintained consistently.

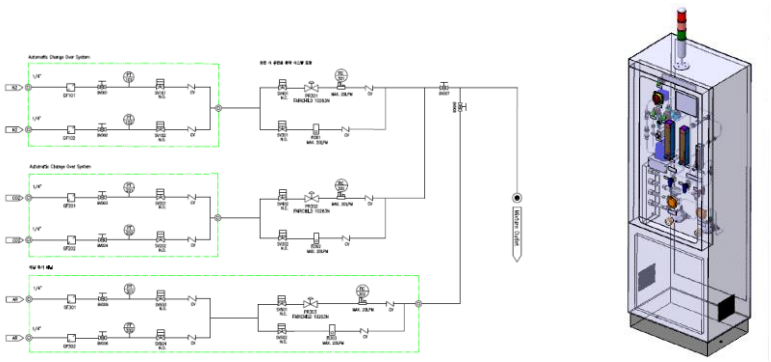

Fig 1. Gas Mixing System P&ID

1.2 Experiment Results and Considerations

The result of Case 1 showed that the mixing ratio was consistent until the point when the pressure difference of inlet and outlet reached 0.5 bar with correction function, but when the correction function was not used, the ratio maintained consistency until the pressure difference over about 2 bar occurred, and the concentration of SF6 was gradually increased under the pressure less than that.

Also, Case 2 showed a tendency similar to Case 1, indicating that the higher the pressure difference of ingredient gas became, the higher the ratio that ingredient gas took in the mixing ratio.

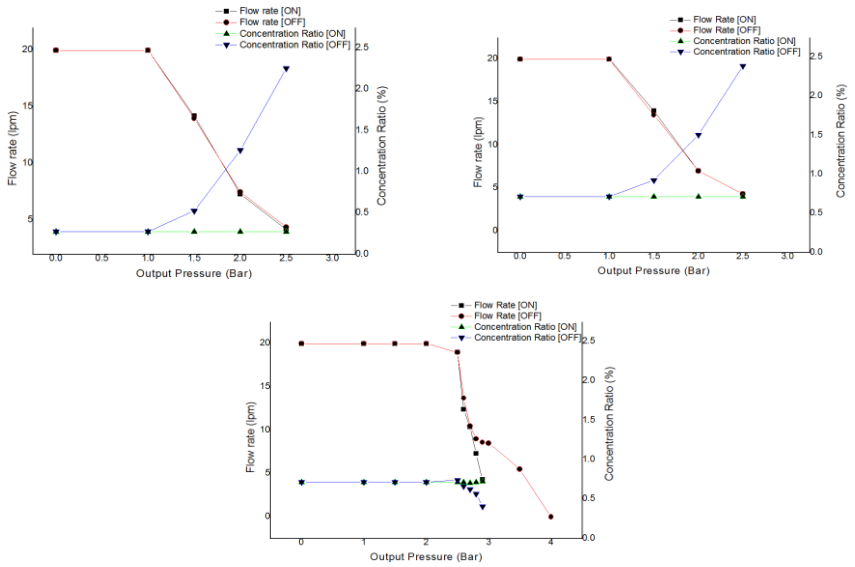

Fig 2. Mixed Gas Flow Rate and Its Concentration of the SF6 according to the Outlet Pressure (Case 1, 2, 3)

In Case 3, because the pressure opposed to Case 3, and the pressure difference of ingredient gas was greater than that of balance gas, it was found that the concentration ratio of balance gas was even higher. When conducting mixing proportion control function, the set mixing concentration maintained very accurate concentration with 0.49 – 0.51% until the pressure difference of inlet and outlet reached less than 0.5[bar], and when mixing proportion control function was not activated, the mixing concentration fluctuated from 0.15 to 2.4% even when the pressure difference of inlet and outlet was over 1.5[bar]. These results indicated that the gas with high pressure affect the concentration of mixed gas.

2 Conclusion

In conclusion, the result of the experiment that used correction function showed that it was not deviated from a certain concentration range until the pressure difference of input and output of ingredient gas (SF6) reached about less than 0.5 bar (the pressure range in which the MFC operates normally), and when the normal operation was difficult because the pressure difference of inlet and outlet was 0.5 bar, the flow release of ingredient and balance gases stopped. However, it was shown that when the correction function was not employed, the flow was released even though the mixing concentration was warped.

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References

1. Ilyoung, Han.: Experimental research for Mass flow sensor factor. KAIST (2001)
2. Menge, Lee., Wonchoul, Jung.: Hybrid MFC design : KAIS,4,63-70,2003

