Fire Sci. Eng., Vol. 29, No. 3, pp. 48-52, 2015 [Research Paper]

미터링 벤츄리를 이용한 포소화약제 혼합장치의 성능개선

주승호 · 공하성* · 공예솜**†
(주)윤영방재엔지니어링, *경일대 소방방재학과, **로고스 국제학교

Improving Performance of Foam Proportioner Utilizing Metering Venturi Type

Seung-Ho Joo · Ha-Sung Kong* · Ye-Som Gong**†
Yoon Young Fire Protection Eng. Co., Ltd.
*Dept. of Fire Safety, Kyungil Univ.
**Logos International School

(Received April 29, 2015; Revised June 10, 2015; Accepted June 10, 2015)

요 약

이 연구는 기존의 미터링 오리피스보다 유량계수가 작은 미터링 벤츄리를 이용하여 포소화약제 혼합장치를 실무에서 주로 사용하는 직경으로 제작하여 혼합비가 적정한지를 평가한 연구로써 3%용 혼합비의 경우 가압수 직경 76.2 mm(포원액 직경 31.75 mm)는 3.1~3.5%의 혼합비의 변화를 나타내었고, 가압수 직경 101.6 mm(포원액 직경 38.1 mm)는 3.3~3.7%의 변화를 나타내어 포소화약제혼합장치등의 성능인증 및 제품검사의 기술기준인 3.0~3.9%를 만족하는 것을 알 수 있었다. 6% 혼합비의 경우 가압수 직경 76.2 mm는 6.4~6.8%의 혼합비의 변화를 나타내었고, 가압수 직경 101.6 mm는 6.25~6.5%의 변화를 나타내어 포소화약제혼합장치등의 성능인증 및 제품검사의 기술기준인 6.0~7.0%를 만족하는 것을 알 수 있었다.

ABSTRACT

In this study, we have evaluated whether the mixing ratio is proper by creating a mixing device for foam proportioner that mainly is employed in practice utilizing a metering venturi type. In case of the mixing ratio for 3%, water under pressure of 76 mm in diameter and the original liquid of a foam fire extinguishing agent of 31.75 mm in diameter have showed up the fluctuation rate just as much as 3.1~3.5% of the mixing ratio. Because water under pressure of 101.6 mm in diameter and the original liquid of a foam fire extinguishing agent of 38.1 mm in diameter have showed up 3.3~3.7% of the fluctuation rate, water under pressure of 101.6 mm in diameter and the original liquid of a foam fire extinguishing agent of 38.1 mm in diameter have satisfied 3.0~3.9% of performance criterion. And also, in case of the 6% of mixture rate, water under pressure of 76.2 mm in diameter and the original liquid of a foam fire extinguishing agent of 31.75 mm in diameter have showed up the fluctuation rate just as much as 6.4~6.8% of the mixing ratio. Because water under pressure of 101.6 mm in diameter and the original liquid of a foam fire extinguishing agent of 38.1 mm in diameter have showed up 6.0~6.8% of the fluctuation rate, water under pressure of 101.6 mm in diameter and the original liquid of a foam fire extinguishing agent of 38.1 mm in diameter have satisfied 6.0~7.0% of performance criterion.

Keywords : Metering venturi type, Foam proportioner, Mixing ratio, Flowmeter, Pressure gauge

1. Introduction

The mixing device for foam proportioner can be defined the device for mixing proper ratio of the foam and water[1]. The researchs of conventional mixing devices for foam proportioner were performed with many researchers including Jae-Hyun Ku[2], Jae-Hyun Ku, Chang-Sun Back, Jun-Yang Park, Byoung-Gyun Na and Hyee-Jung Park[3] investigated the effect of the device variables, such as the amount of liquid, pressure, area of the orifice for improve the device performance, Jang-Won Lee, Woo-Sub Lim and Dong-Ho Rie[4] investigated the effect of the ratio of the synthesized surfactant foam proportioner vs aqueous membrane foam proportioner with 1:4, 1:7 and 1:10 ratios to the

† Corresponding Author, E-Mail: som-vely@naver.com
TEL: +82-51-988-8210, FAX: +82-51-746-8201

ISSN: 1738-7167
DOI: http://dx.doi.org/10.7731/KIFSE.2015.29.3.048

※본 논문은 '연구부정행위'의 '부당한 저자 표시'로 판정되어 논문게재가 철회된 논문임.

performance of the fire extinguisher, Seung-Ho Joo, Man-Taek Lim, Hye-Won Kim and Ha-Sung Kong[5] studied the proof of the improvement of the foam proportioner by changing the conventional metering orifice pattern to metering venturi pattern.

The investigation of the mixing device for foam proportioner has not been widely studied. Moreover, the investigation of the satisfaction for the currently using the metering venturi pattern to the standard KFIS 011 has not been studied yet.

In this investigation, the equations (1) and (2) were utilized for calculate the amount of foam and water and the mixing ratio of foam.

$$\text{The amount of foam and water} = Qw + Qc \quad (1)$$

$$\text{Mixing ratio} = \frac{Qc}{Qw + Qc} \times 100(\%) \quad (2)$$

where, Qw: the amount of water (LPM), Qc: the amount of foam (LPM)

In this study, metering venturi with smaller flow coefficient compared with conventional 76.2 or 101.6 mm metering orifice was fabricated and used to prove the proper mixing ratio of 3 and 6%[6].

2. Experimental

2.1 Fabrication the device and performance test

Figure 1 shows the pressurized water device with the diameter of 76.2 and 101.6 mm for 31.75 and 38.1 mm of the diameter for the pressurized water, respectively. The performances were tested with the mixing ratios of 3 and 6%.

2.2 Experimental method

Table 1 shows the specifications of the flowmeter. The water proof rating IP67 and magnetic flow meter were utilized for measuring the amount of water.

Table 1. Specifications of Flowmeter

Classification	Content	Standard
Flowmeter (water)	Magnetic flowmeter	-
	Nominal diameter	150 mm
	Protection	IP67
	Size	152.4 mm
Flowmeter (foam concentrate)	Magnetic flowmeter	-
	Nominal diameter	50 mm
	Protection	IP67
	Size	50.8 mm

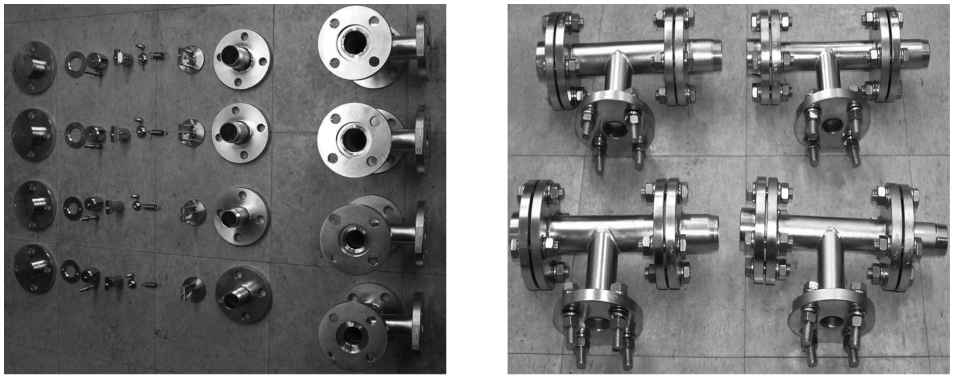
Table 2. Specifications of Pressure Gauge

Classification	Content	Standard
Pressure gauge (water and foam concentrate)	Type	Oil-including type
	Allowable pressure	0~2.5 MPa
	External diameter of pressure gauge	100 mm
	Connection standard	9.5 mm
	Quality of the body	STS 304

Table 2 shows the specifications of the pressure meter. Oil integrated, 0~2.5 MPa, 100 mm of outside diameter, and 9.5 mm connector bourdon tube pressure meter was utilized for pressure measurement.

2.3 Experimental condition

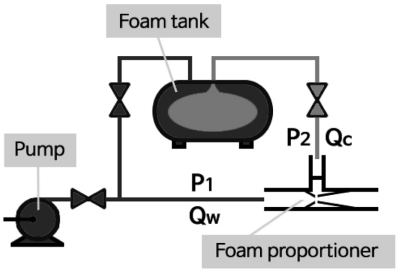
Figure 2(a) shows the foam tank, mixer of the foam proportioner, flower meter, and pressure meter for measuring the mixing ratio of the materials. Figure 2(b) shows the experimental setup for mixing ratio measurement. The data



(a) Disjointing state (b) Construction state

Figure 1. Prototyping of foam proportioner.

(a) Experimental apparatus



(b) Pressure, flow measurement position

Figure 2. Experimental apparatus and pressure, flow measurement position for measuring the mixing ratio.

were averaged for measuring for certain period of time due to the large variation of the measured data using magnetic flowmeter.

3. Results and Discussion

3.1 Experimental results

Table 3~6 shows the experimental results of the mixing ratios of foam and water and foam proportioner. The pressure of the pump dispensing-side was set to 0.7 MPa due to the pressure was proper water shot. The technical standards for authentication and production inspection for 3 and 6% were 3.0~3.9% and 6.0~7.0%, respectively[7].

3.2 The graph of experimental results

Figure 3 shows the experimental results for the amount

Table 3. Diameter of Water 76.2 mm for 3%

P_1 (MPa)	P_2 (MPa)	Q_w (LPM)	Q_c (LPM)	Amount of foam and water (LPM)	Mixing ratio (%)	
					Estimation data	Technological standard
0.07	0.06	962	31	993	3.1	3.0~3.9
0.15	0.14	1,380	46	1,426	3.2	
0.35	0.33	2,015	69	2,084	3.3	
0.55	0.54	2,546	90	2,636	3.4	
1.05	1.04	3,584	130	3,714	3.5	

Table 4. Diameter of Water 76.2 mm for 6%

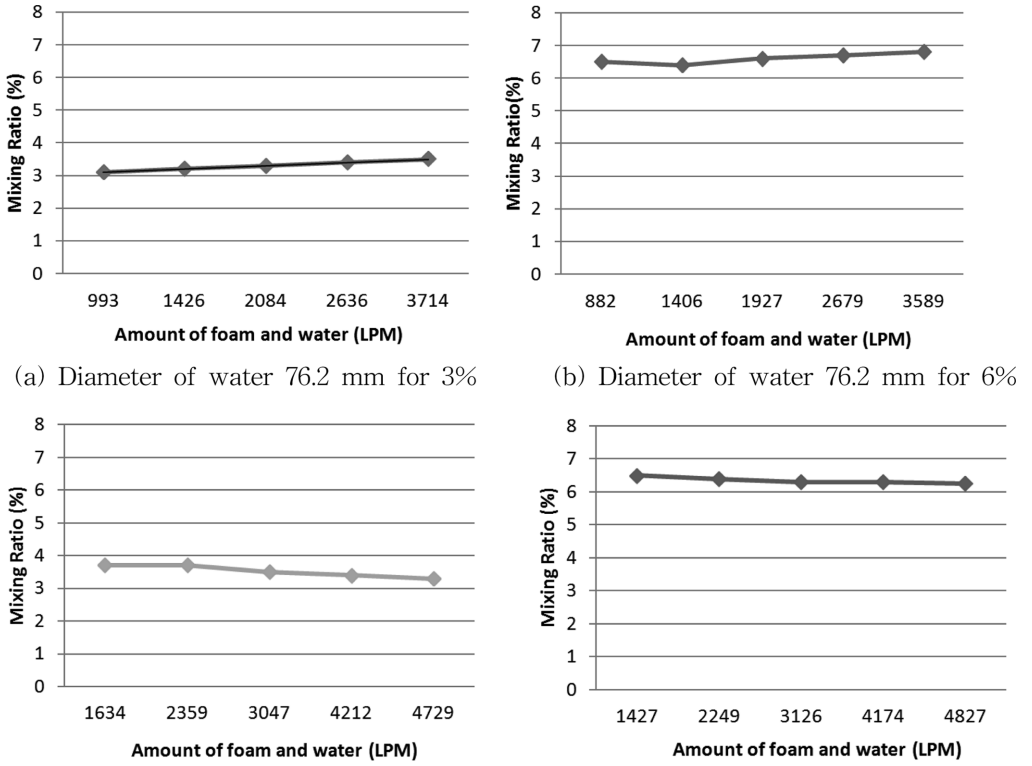
P_1 (MPa)	P_2 (MPa)	Q_w (LPM)	Q_c (LPM)	Amount of foam and water (LPM)	Mixing ratio (%)	
					Estimation data	Technological standard
0.07	0.06	825	57	882	6.5	6.0~7.0
0.15	0.14	1,316	90	1,406	6.4	
0.35	0.33	1,800	127	1,927	6.6	
0.55	0.54	2,500	179	2,679	6.7	
1.05	1.04	3,345	244	3,589	6.8	

Table 5. Diameter of Water 101.6 mm for 3%

P_1 (MPa)	P_2 (MPa)	Q_w (LPM)	Q_c (LPM)	Amount of foam and water (LPM)	Mixing ratio (%)	
					Estimation data	Technological standard
0.07	0.06	1,574	60	1,634	3.7	3.0~3.9
0.15	0.14	2,272	87	2,359	3.7	
0.35	0.33	2,940	107	3,047	3.5	
0.55	0.54	4,069	143	4,212	3.4	
1.05	1.04	4,573	156	4,729	3.3	

Table 6. Diameter of Water 101.6 mm for 6%

P_1 (MPa)	P_2 (MPa)	Q_w (LPM)	Q_c (LPM)	Amount of foam and water (LPM)	Mixing ratio (%)	
					Estimation data	Technological standard
0.07	0.06	1,334	93	1,427	6.5	6.0~7.0
0.15	0.14	2,105	144	2,249	6.4	
0.35	0.33	2,929	197	3,126	6.3	
0.55	0.54	3,911	263	4,174	6.3	
1.05	1.04	4,525	302	4,827	6.25	



(a) Diameter of water 76.2 mm for 3% (b) Diameter of water 76.2 mm for 6%

(c) Diameter of water 101.6 mm for 3% (d) Diameter of water 101.6 mm for 6%

Figure 3. Amount of foam and water and the mixing ratio of foam proportioner.

of foam and water of foam proportioner and its mixing ratio. The mixing ratios of 76.2 and 101.6 mm for 3% were 3.1~ 3.5 and 3.3~3.7%, respectively, and the ratios of 76.2 and 101.6 mm for 6% were 6.4~6.8 and 6.25~6.5%, respectively.

4. Conclusions

This research was performed for the proof of the proper mixing ratios for metering venturi having smaller flower coefficient than the metering orifice. The results are the followings:

(1) For the mixing ratio of 3%, the ratios were 3.1~3.5 and 3.3~3.7% for the water diameter of 76.2 and 101.6 mm, respectively. The results are in the range of technical standards for authentication and production inspection (3.0~3.9%).

(2) For the mixing ratio 6%, the ratios were 6.4~6.8 and 6.25~6.5% for the water diameter of 76.2 and 101.6 mm, respectively. The results are in the range of technical standards for authentication and production inspection (6.0~7.0%).

The similar research will be performed with the metering orifice and will compare with the current results.

References

1. Foam Proportioner and also Technological Standards for

Product Inspection Article 2 No. 1, Notification No. 2015-45 of Ministry of Public Safety and Security (2015).
2. J. H. Ku, “A Study on Foam Mixing Characteristics in Steady steady to Enhance the Performance of Proportioner for Foam System”, Journal of the Korean Society of Hazard Mitigation, Vol. 9, No. 5, pp. 63-68 (2009).
3. J. H. Ku, C. S. Baek, J. Y. Park, B. G. Na and H. J. Park, “A Experimental Study on the Foam Mixing Characteristics of Proportioner for Foam System”, Proceedings of Fall Annual Conference, Korean Institute of Fire Science & Engineering, pp. 217-224 (2003).
4. J. W. Lee, W. S. Lim and D. H. Rie, “A Study on B Class Fire Extinguishing Performance of Air Ratio in the Compressed Air Foam System”, Journal of the Korean Society of Hazard Mitigation, Vol. 27, No. 6, pp. 8-14 (2013).
5. S. H. Joo, M. T. Lim, H. W. Kim and H. S. Kong, “The Methods to Improve the In-Line Eductor”, Journal of Korea Safety Management & Science, Vol. 13, No. 2, pp. 275 (2011).
6. S. H. Joo, M. T. Lim, H. W. Kim and H. S. Kong, “The Methods to Improve the In-Line Eductor”, Journal of Korea Safety Management & Science, Vol. 13, No. 2, pp. 280-281 (2011).
7. Foam Proportioner and also Technological Standards for Product Inspection Article 10, Notification No. 2015-45 of Ministry of Public Safety and Security (2015).