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Atomization Characteristics of Effervescent Atomizer with the Variations of Operating Conditions

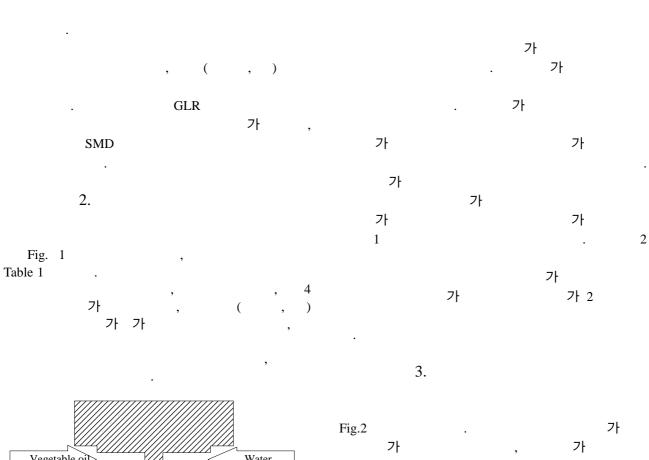
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Key Words: Effervescent atomizer(), LDPA(Laser Doppler Particle Analyzer), SMD(Sauter mean diameter), Spray angle()

Abstract

The atomization characteristics were investigated through the influence of the change of GLR and the change of working fluid on droplet size distribution and mean diameter of drop produced by effervescent atomizer. For simultaneous injection of water and high viscous waste vegetable oil, effervescent atomizer with two aerator tubes was specially designed. From the experimental results, regardless of mass fraction of vegetable oil in working fluids, it is expected that effervescent atomizer will exhibit excellent atomization performance at the high GLR conditions.

				1.		
GLR	가 /					
F(D)						
$F(D^3)$,			
Frr	Rosin-Rammler					
\dot{m}_G	가	, g/s				
\dot{m}_L		, g/s			(1),(2)	
\dot{m}_W		, g/s	(2),(3)	(4),(6)	(1),(7)~(11)	
\dot{m}_{VO}		, g/s			•	
Φ			71			
	$=\dot{m}_W/\dot{m}_L$		가			
q	Rosin-Rammler					가
SMD	Sauter , µm					가
X	Rosin-Rammler	, μm				71
					가	
† 가						
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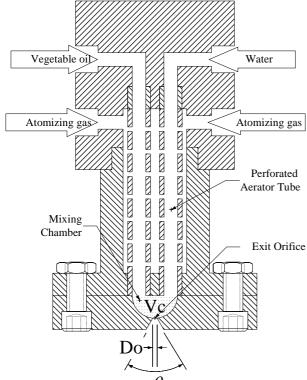
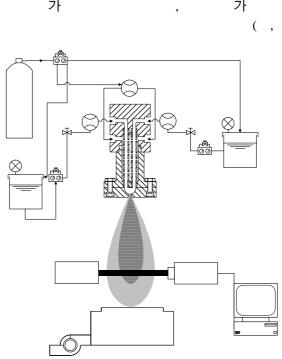


Fig. 1 Schematic diagram of effervescent atomizer

Table 1 Atomizer geometry

Nozzle exit orifice diameter, D_o	2.5 mm
Diffusion angle, θ	60°
Volume of mixing chamber, V_c	$1.89 \times 10^{-5} m^3$



- 1. Effervescent atomizer
- 2. Water strage tank
- 3. Vegetable oil strage tank 5. Regulator
- 4. Pressure gaugage
- 6. Valve
- 8. Nitrogen tank
- 7. Flow meter
- 9. Spray receiver
- 10. Suction blower
- 11. He-Ne laser

12. Detector

13. Computer (image grabber)

Fig. 2 Schematic diagram of experimental set-up

4. 가 가 4.1 Fig.3 2.8g/sGLR (Fraunhofer) 가 가 GLR가 1750 μm 가 566mm **R**6 가 가 가 26mm 150mm vignetting GLR=0.071~0.107 600mm 가 GLR=0.107 (multi-가 scattering) GLR (10kg/hr) 2.8g/s((4) Chen GLR (GLR=0~0.12) 0.3g0.6g가 2.8g/s0, 0.4, 1.4, 2.0, 2.8g/s 가 0.00~1.00 5 가 . Table 2, 3 Chen

Table 2 Experimental conditions

Liquid	Water, Vegetable oil
Liquid mass flow rate	2.8 g/s
Liquid mixing rate, Φ	0.00 ~ 1.00
Atomizing gas	Nitrogen
Air mass flow rate	0.3, 0.4, 0.5, 0.6 g/s
ALR (-)	0.107, 0.143, 0.179, 0.214

Table 3 Properties of working fluids

Liquid	Density (kg/m^3)	Viscosity $(kg/m \cdot s)$	
Water	998.2	0.001	
Vegetable oil	907.6	0.066	

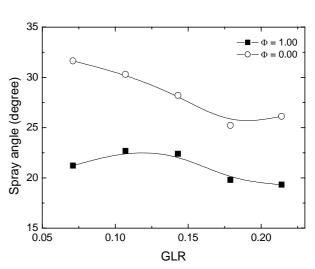
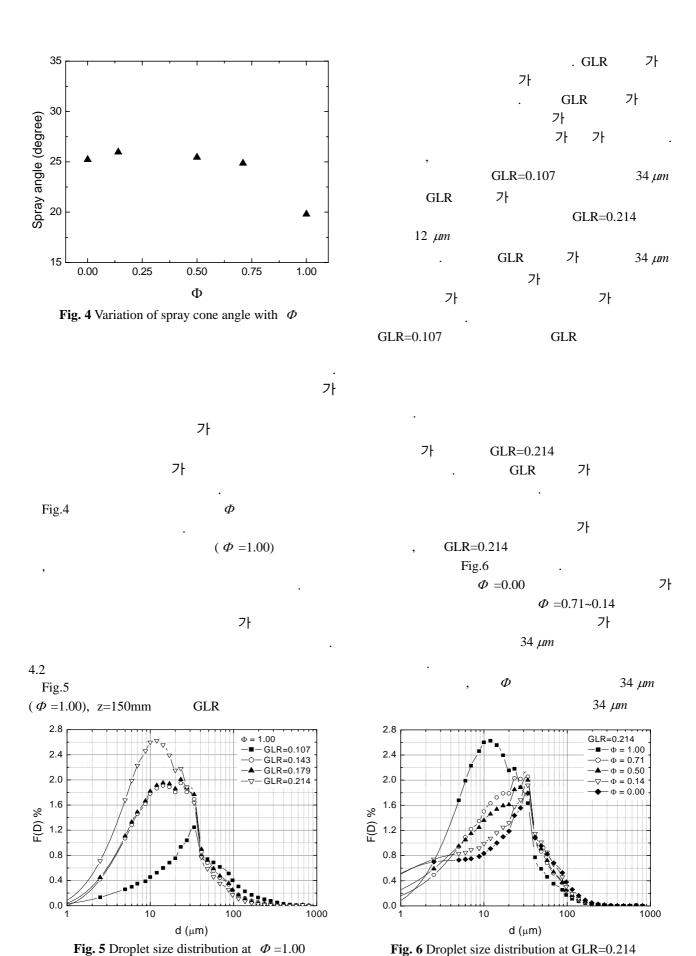


Fig. 3 Variation of spray cone angle with GLR



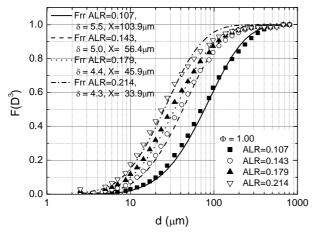


Fig. 7 Droplet size distribution functions at $\Phi = 1.00$

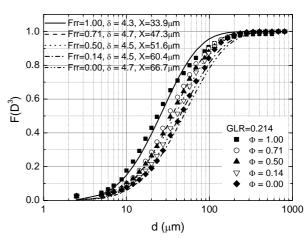


Fig. 8 Droplet size distribution functions at GLR=0.214

Fig.7 $(\Phi = 1.00), z=150$ mm GLR Rosin-Rammler 가 가 GLR GLR 가 가 Rosin-Rammler X 가 GLR=0.107 103.9 μm 가 33.9 µm GLR=0.214 가 q 가 가

가

Rosin-Rammler

4.3 Fig.9 7, (SMD)

가

GLR Fig.9 GLR 7\(\text{GLR} \) . GLR 7\(\text{GLR} \) . $\Phi = 1$ GLR (GLR=0.179-0.143) GLR

GLR

가

가 GLR 가 Lefebvre et al. $^{(7)}$, Li et al. $^{(8)}$.

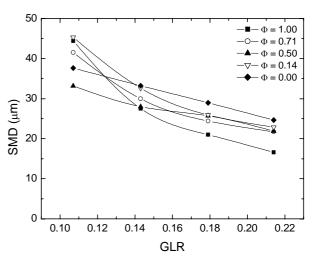


Fig. 9 Variations of SMD with GLR

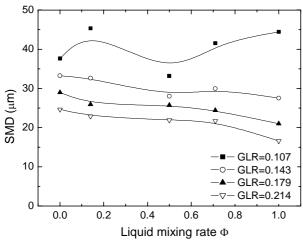


Fig.10 Variations of SMD with liquid mixing rate

GLR

5.

가 2 가

GLR

- 1) 가 가 ,
- 2) 가 가

5) , GLR

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