3P4-5

Effect of horn and liquid height in ultrasonic atomization

超音波霧化におけるホーンおよび水位の影響

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1. Introduction

Ultrasonic atomization technique is used to generate mist of small water droplets of several micrometers in diameter. When water is irradiated with ultrasound of MHz range, a water surface vibrates intensely and small droplets are separated from the water surface[1]. The mist increases humidity by evaporation because a smaller droplet has a larger surface area relative to its volume.

The influence of the distance between a liquid surface and the transducer is studied experimentally on the atomization rate[2]. A horn is attached to the transducer in order to study effect of a horn[3]. It studied effect of horn. Mist formation rate is experimentally measured for various diatances between a liquid surface and the surface of transducer with / without horn.

2. Experimental apparatus

Figure 1 shows a basic experimental system. Figure 2 shows a transducer and a horn. The transducer is circular plate disk of 20 mm in diameter and 2.4 MHz in resonance frequency. The sound pressure distribution is measured experimentally. The position of the maximum sound pressure is 50 mm from the transducer surface. When a horn is attached to a transducer, high sound pressure is generated on the beam axis. The transducer was settled in the center of the bottom surface in the water tank which size is 142 mm x 142 mm x 195 mm. When the transducer is driven by a function generator (NF, WF1946B) and an amplifier (ENI, 325LA), it radiates a sound wave into the water, and vibrates the water surface. It generates atomization. The voltage of the transducer is about 80 Vpp, the electric power is 16 W. The weight of the water tank is measured every second with a electric scale (A&D, FX-5000i) and recorded on PC. The water tank was filled with mists during the generation of mists. To remove mists, it sent air in a fun. Figure 3 shows a photograph of the experiment.

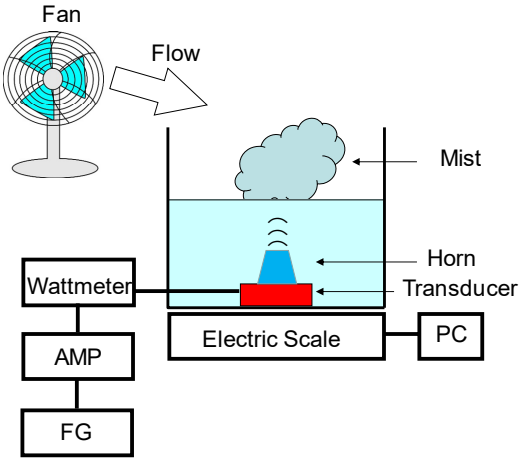

Fig. 1 Experimental apparatus.

Fig. 2 The transducer and a horn.

Fig. 3 Atomization experiment equipment.

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3. Experimental result

Figure 4 shows the experimentally measured weight-time curve for the water level of 30 mm. The mist generation started at t=30 s. After that time, the weight was measured for 360 s. The volume of generated mist measured for 5 minutes. The rate of the mist generate per one hour calculated the volume 12 times.

Figure 5 shows the experimentally measured mist volume as a function of water level with and without a horn. When the water level is from 15 mm to 50 mm, the mist was generated. For the water level of 30 mm or 35 mm, the generated mist volume was the maximum. Moreover, the amount of mist was larger with a horn.

Figure 6 show the images of the atomization just after the start of atomization with and without a horn. With a horn, the surface area of water is larger due to the appearance of thinner and longly fountain. This would be the reason for the larger amount of mists with a horn compared to that without a horn.

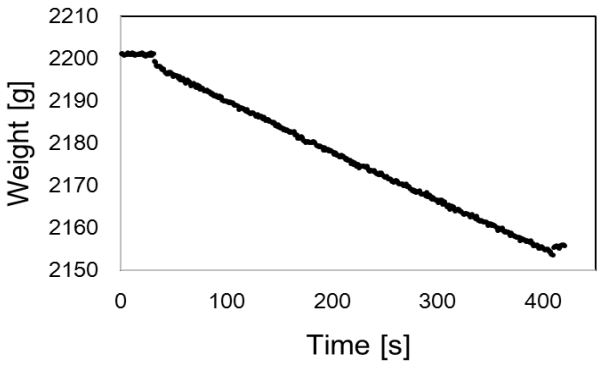


Fig. 4 Weight-time curve.

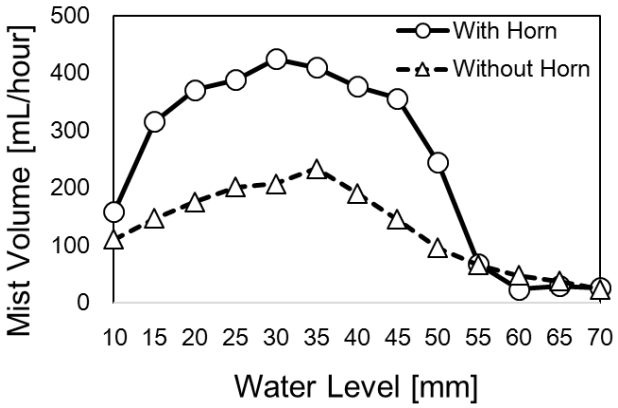
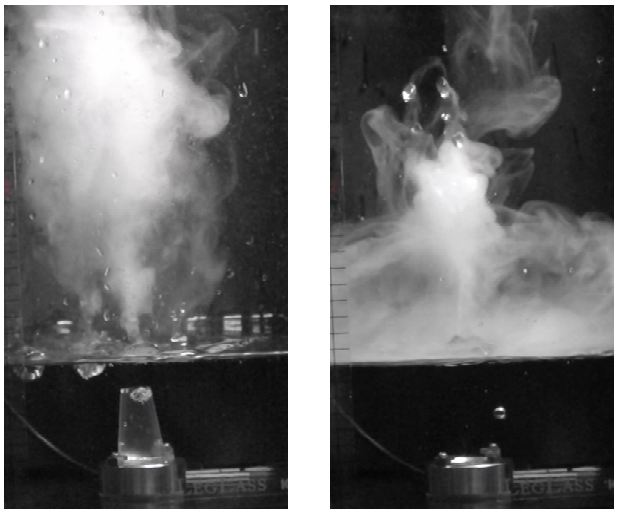


Fig. 5 Total volume of mists as a function of water level.



(a) With a horn (b) without a horn

Fig. 6 Images of the atomization.

4. Conclusion

This paper shows the influence of liquid height on mist production rate in ultrasonic atomization with / without horn. The mist was generated for the water level of 15 mm - 50 mm. The amount of mists was larger with a horn compared to that without a horn.

References

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