Performance Testing of a Handheld Nebulizer

T.H. Yang [1], N. Yu[1], Y.M. Kuo[2], S.H. Huang[1], C.C. Chen[1]

[1] Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University, Taipei 10055, Taiwan
[2] Department of Occupational Safety and Health, Chung- hwa University of Medical Technology, Tainan, Taiwan
Keywords: orientation independent, nebulizer, hand-held generator
Presenting author email: kuoyumei@yahoo.com.tw

Vibrating mesh aerosol generators have been reported to have increased output efficiency, minimal residual volume, and high percentage of particles in the emitted respirable and fine particle fraction. This work aimed to thoroughly characterize a miniaturized vibrating mesh nebulizer, uniquely applying capillary force for solution delivery.

The miniaturized vibrating mesh aerosol nebulizer tested in this work consisted of a nebulization unit, a liquid reservoir and a transport device. One triple-A battery was used to power the nebulizer, in order to miniaturize the device and operate for long hours. The vibrating mesh plate was placed on top of the solution transport device which was composed of two circular tubes, designed to deliver solution by capillary force. The aperture size of vibrating mesh plate was 15 μm. There were 2375 tapered holes on the mesh and the aperture distance was around 160 μm. The effect of the orientation, including vertical, horizontal, and up-side-down, of the nebulizer was also investigated. An aerosol size spectrometer (Welas 3000, Palas) was employed to measure the aerosol number concentration and size distribution. This nebulizer was mainly evaluated with 0.9% sodium chloride solution.

The power consumption of this device was only 0.925 watt. It could continuously operate for over 6 hours. The feeding rate was around 0.15 mL/min and only negligibly affected by the device orientation. However the residual was slightly influenced by the orientation, 7.0%, 5.6%, 2.6% for vertical, horizontal and up-side-down, respectively. The count median diameter of the aerosol output was around 0.55 μm, with geometric standard deviation about 2. The aerosol number concentrations were 6,878, 11,724, and 16,101 #/cm^3 for vertical, horizontal, and up-side-down, respectively.

The most significant feature of this hand-held nebulizer was almost orientation independent. This made it ideal for medical use, especially for patients lying on bed. However, there were many applications in the field of occupational hygiene, such as qualitative fit testing, and smoke stream generation. It could also become an exceptionally energy-saving humidifier. The aperture size and number on the vibrating mesh plate could be changed to improve the aerosol size and concentration. The residual volume could be further reduced by adjusting the design of the solution transport devise.

This work was supported by the Institute of Labor, Occupational Safety and Health, Ministry of Labor, Taiwan, under grant ILOSH-1040049.

Waldrep, J. C., & Dhand, R. (2008). *Curr Drug Deliv*, 5(2), 114-119.

Watts, A.B., McConville, J.T., & Williams, R.O. (2008). *Drug Development and Industrial Pharmacy*, 34(9), 913-922.

Zhang, G. F., David, A., & Wiedmann, T. S. (2007). *Journal of Aerosol Medicine-Deposition Clearance and Effects in the Lung*, 20(4), 408-416.