DIAMETER & VELOCITY TRENDS OF A MEDICAL INHALER SPRAY

APPLICATION NOTE PDPA-003

Sprays can be continuous or transient. Transient sprays are by nature different from continuous sprays because they include a start and stop process. When sprays are used to disperse a medicine in the nose or mouth, we need to pay particular attention to the spray characteristics in order to ensure the safety of this technique. The opening and closing process of the MDI atomizer could introduce abnormally large and It is possible that the spray quality degrades as the plume stops, resulting in very large droplets, which could present a hazard in terms of the volume of medication within each one. The droplet diameter and velocity generated during the beginning and ending portions of the spray process are usually different from those during the steady-state part of the spray process, and these should be measured.

A 1D PDPA was set up with a 300 mW laser, FBL-1 fiberlight™ beam generator, and TM250 transmitter probe. Signals were captured by a RV1070 receiver and sent to a PDM1000-1P detector module. An FSA 3500-1P signal processor and FLOWSIZER™ software were used to analyze the data. The operation of these components can be observed in the Phase Doppler Applications brochure, available on www.tsi.com. A custom MDI test stand was used, which produced an output signal at the start of aerosol generation. A custom MDI test stand was used, which produced an output signal at the start of aerosol generation. This signal was fed into the FSA to allow multiple MDI activations to be recorded with the same initial reference time. All measurements here were done at a location 25 mm downstream from the MDI outlet. Figure 1 shows time-integrated diameter and velocity histograms for the entire spray process: beginning/steady-state/ending. While overall mean values can be obtained from these results, no information on temporal evolution of diameter or velocity is provided.

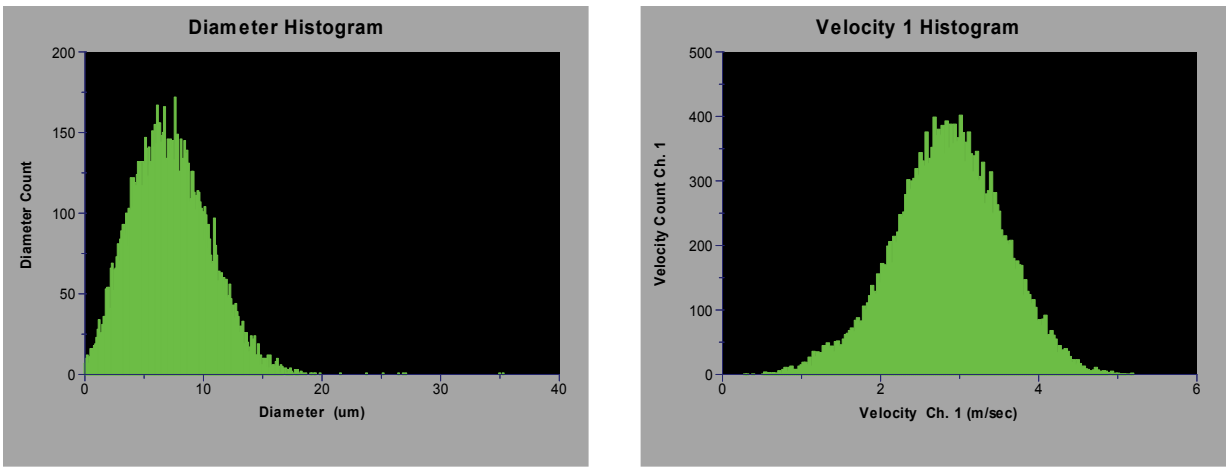

Figure 1: Measured diameter and velocity histograms for the entire spray process. Measurements were made on the plume centerline, 25mm from the MDI outlet.

Figure 2 shows transient measured results for a single MDI unit. Several interesting observations can be pointed out from the figure. A single activation produces aerosol for about 250 ms. It takes about 50 ms for the plume to reach the measurement point. The diameter data show a fairly constant diameter up to about 300 ms, when it decreases slightly. The velocity remains fairly constant at about 3 m/s until 200 ms, then it begins to decay slowly. There is a significant amount of variation in velocity, with readings ranging from 1 m/s to 5 m/s. This would indicate higher levels of shear and enhanced mixing.

The above results illustrate some of the transient analysis one can perform with data obtained using a TSI PDPA. For measurement of profiles through the plume, a computer-controlled traverse system can be used with the PDPA. Manual or fully automatic scans can be made.

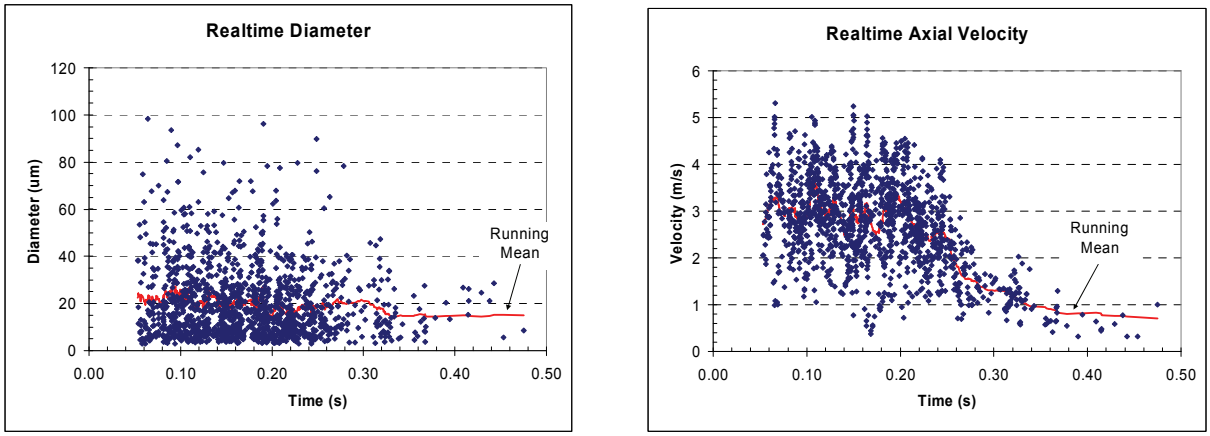

Figure 2: Measured transient diameter velocity in the MDI plume. Running mean values are indicated by the (red) line. Measurements were made on the plume centerline, 25 mm from the MDI outlet.

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