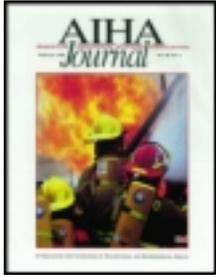


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# An improved constant output atomizer

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**An improved atomizer based on the design of Liu and Lee has been developed. The atomizer requires a solution feed rate of only 0.1 mL/min for a stable output. A monodisperse aerosol generator can be obtained using an electrostatic classifier and the system is capable of continuous operation for extended periods of over 24 hours depending on the size of the solution reservoir used.**

## introduction

Elucidation of an aerodynamic characteristic of an aerosol in inhalation studies or the evaluation of a particle sampling instrument necessitates the generation of a well defined aerosol. Previous work<sup>(1,2)</sup> has led to the development of a monodisperse fine particle generator using a constant output atomizer with an electrostatic classifier. Monodisperse particles 0.01 to 0.2 μm diameter with a well defined charge are produced by electrical mobility classification. Particle concentrations can be easily determined using an aerosol electrometer.<sup>(2)</sup>

The atomizer developed by Liu and Lee is exceptionally stable, not having the problem of solvent evaporation from the solution reservoir of such atomizers as the Collison or the Lovelace. However, for a stable output a minimum solution feed rate of 0.59 mL/min is required at an operating pressure of 248 kPa (35 lbs) and the duration of operation is limited by the size of the syringe used. In addition, occasional instability can occur due to drops dripping down from the constriction at the outlet of the atomizer.<sup>(3)</sup> An improved atomizer has been developed to overcome these problems.

## apparatus

The improved design is illustrated in Figure 1. A straight flow through passage with no constriction in the aerosol outlet is utilized. The size of the passage was chosen to be 2.11 cm (3/8 in.) diameter primarily because 2.11 cm tubing used for connections was readily available. The size of the orifice in the 2.11 cm disk is increased to 0.0406 cm (0.0160 in.) from 0.0343 cm (0.0135 in.) to obtain a higher aerosol flow rate. A constant pressure feed is used instead of a syringe pump. The solution feed rate is controlled by a micrometer valve and monitored by a flowmeter as shown in Figure 2. The solution is drawn from the bottom of the reservoir. With this arrangement a constant feed of long duration can be obtained by using a large cross sectional area solution reservoir.

The atomizer was evaluated using a 1% solution of uranine. The calibration system is illustrated in Figure 2. The aerosol from the atomizer was dried in a diffusion dryer

using silica gel. The dry aerosol was classified by electrical mobility by the electrostatic classifier (TSI 3071) and monodisperse particles of a selected size were produced. At 248 kPa (36 lbs) operating pressure on the atomizer, a monodisperse aerosol was produced at 3.9 Lpm. The aerosol was diluted with clean dry air at 20 Lpm in the aerosol chamber. Particle concentration was measured by an aerosol electrometer (TSI 3068).

## results

Figure 3 shows the output of the monodisperse aerosol generating system with 20 Lpm of dilution air as a function of a particle diameter for different solution feed rates at an operating pressure of 248 kPa. Feed rates higher than 0.35 mL/min did not produce any significant increase in the

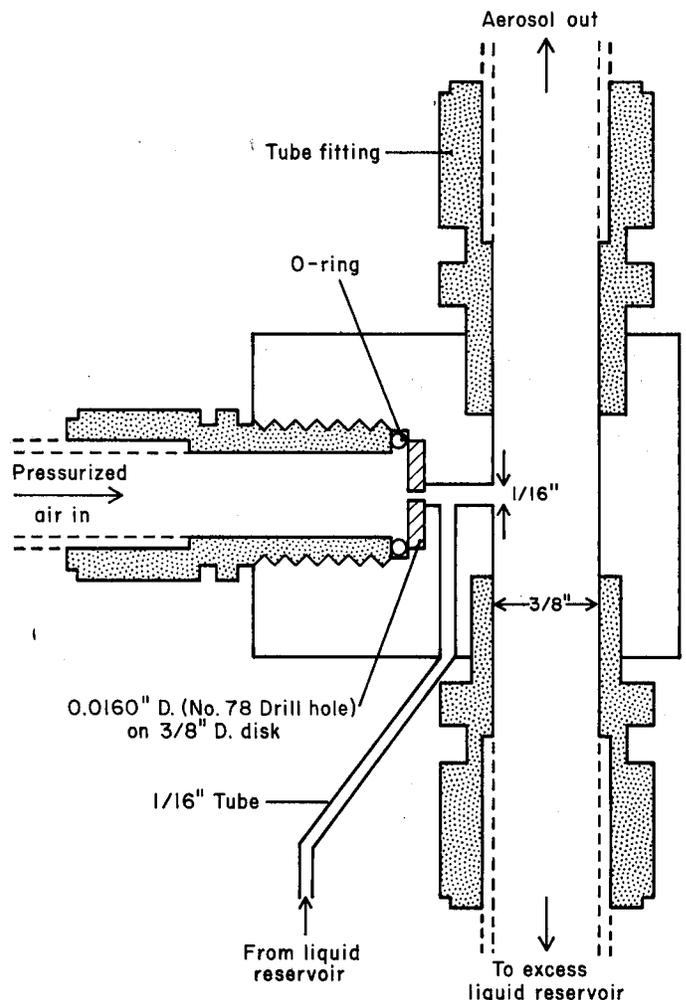


Figure 1 — Improved atomizer design.

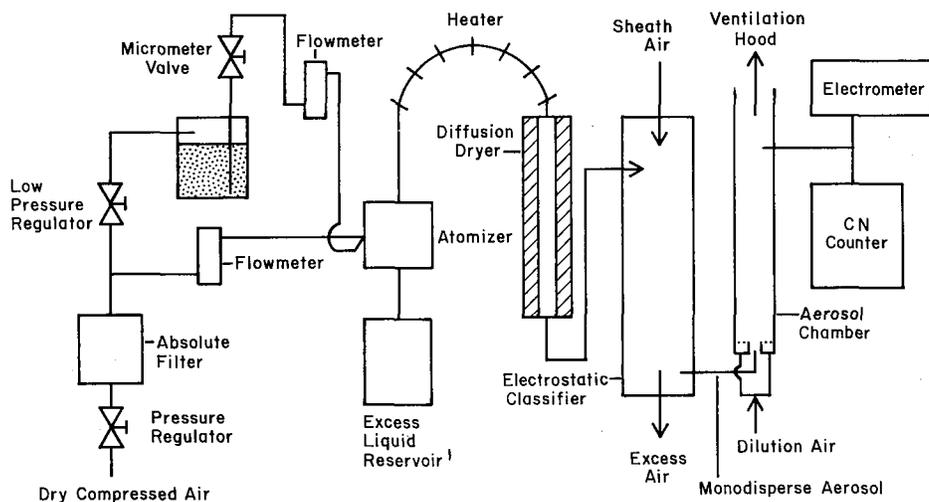


Figure 2 — Calibration system for monodisperse aerosol generator.

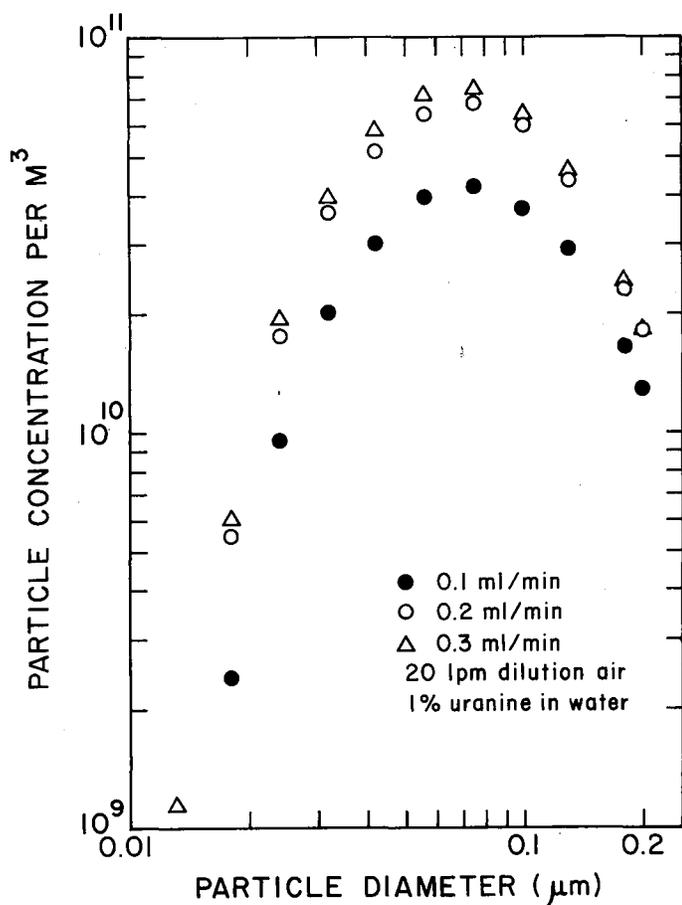


Figure 3 — Particle concentration as a function of particle diameter.

particle concentrations because of the decrease in atomizing efficiency. It could be observed that an increase in the flow of liquid to the excess liquid reservoir occurred at the higher feed rates. The minimum feed rate for a stable output is about 0.1 mL/min which is substantially lower than the value of 0.59 mL/min for the previous design.<sup>(1)</sup> The stability of the monodisperse generating system using uranine solution is approximately  $\pm 5\%$  and is shown in Figure 4.

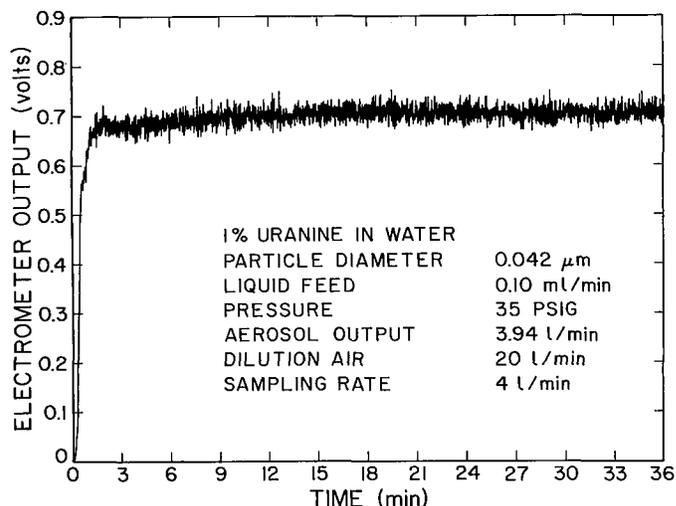


Figure 4 — Stability of monodisperse particle generator in terms of electrometer output as a function of time.

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