RECORDING METERED DOSE INHALER FLUMES BY TIMED SEQUENCE FLASH PHOTOGRAPHY

G.W. Hallworth and D. Kedgley, Glaxo Group Research Ltd., Ware, Herts, SG12 0DJ

The pulmonary deposition and hence clinical efficacy of metered dose inhalers (MDI) are critically dependent on the discharged spray characteristics. The diameter, velocity and density of large drug particles (mostly as droplets) at relevant flight distances from the actuator, together with the associated profile and orientation of the spray flume, dictate impactional losses in the actuator mouthpiece, oropharynx and lower large airways. These spray characteristics are controlled by the formulation and design of the actuator and metering valve. Flume assessment is thus an important corollary to complex measurements of droplet characteristics and may aid the design of such measurements. Although impaction techniques have been used for both continuous spray aerosol dispensers (Mumford and Dixon 1966) and MDI's (Benjamin et al 1983), one which does not disturb the flume is more suitable and should be preferably less elaborate and expensive than video (Miszuk et al 1980).
Flash photography meets these requirements, but for metered products, instead of using a long (0.5s) exposure time (Benjamin 1983), more information is obtained using shorter timed sequences. We have developed this technique by using a microphone to detect the sound of initial discharge, which triggers the flash unit through a preset time delay switch. This enables single metered shots to be recorded at known time intervals after firing the inhaler. A series of placebo inhalers of varying propellant and miscible excipient content (Table 1) were fired and photographed. The total and dense region flume lengths were measured from photographs (Fig 1), there was little variation in general shape (length/breadth). The results all demonstrate characteristic rapid flume development and expansion and then dissipation into a cloud, with rapid deceleration after the initial high flume tip velocity. The low pressure propellant blend (D) revealed large droplets in all three flumes, whilst the marked persistence of flumes due to excipients (H to K) is evident.

Table 1. Inhaler Formulations (% w/w)

Ref	Propellants			Excipients	
	P12	P11	P114	S	E
A	100	–	–	–	–
B	80	20	–	–	–
C	60	40	–	–	–
D	40	60	–	–	–
E	50	25	25	–	–
F	60	–	40	–	–
G	60	40	–	0.15	–
H	60	40	–	0.75	–
I	60	40	–	3.0	–
J	60		40	–	20
K	60		40	–	33

S = Span 85 E = Ethanol

The excipient percentages are each additive to the 60/40 propellant blends.

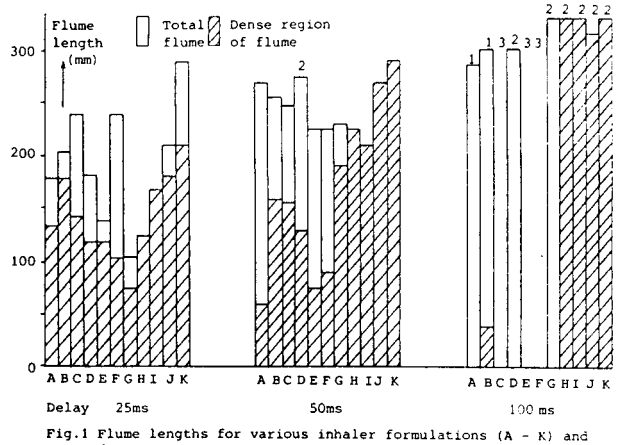

Fig.1 Flume lengths for various inhaler formulations (A - K) and delay times (millisecs).
Key : Due to poor flume contrast, flume length was either (1) only approximate (2) probably longer than shown, or (3) not measurable.

Benjamin, E.J. et al (1983) J.Pharm.Sci 72:380-385
Mumford, R.M. and Dixon, K. (1966) Int. Encyclop. of Pressurized Packaging (Aerosols), Ed A. Herzka, Pergamon Press, Chapter 11.
Miszuk, S. et al (1980). J. Pharm. Sci. 69: 713-717
Turner, K.J. (1980) Aerosol Age 25: 24-30