

Performance of high-flow permeation tubes releasing SF₆

R.S. Hegarty¹, R.T. Woodgate¹ and D.A. Clark²

¹NSW Agriculture Beef Industry Centre, University of New England, Armidale NSW 2351

²Dexcel, Private Bag 3221, Hamilton, New Zealand

roger.hegarty@agric.nsw.gov.au

Ruminal methane production rate can be estimated from the ratio of methane and SF₆ in expired air, following administration of an intraruminal permeation tube releasing the inert tracer gas SF₆ (Johnson *et al.* 1994). Release characteristics of such permeation tubes have been well characterised (Lassey *et al.* 2001) with release rates of 0.6–1.7 mg SF₆/d, leading to SF₆ concentrations of 20–800 parts per trillion (10⁻⁶µl/l) in samples of expired air. These levels are below the detection limits for infrared spectroscopy, so permeation tubes providing faster delivery of SF₆ were developed to achieve higher SF₆ concentrations in expired air, able to be measured by a photo-acoustic infrared gas analyser.

Aluminium bodied tubes able to hold up to 6 g of SF₆ were manufactured and loaded with 3.7 g of SF₆ for this study. Permeation windows (2.5 cm diameter, 125 µm thick PTFE) were fitted to both ends of the tube, with the PTFE membrane being secured between a 2.5 cm stainless steel sintered frit (2 µm pore size) and a polyvinyl chloride washer. Tubes were cooled in liquid nitrogen, filled with approximately 800 ml of SF₆ and sealed.

The change in weight of individual tubes was strongly linear ($r^2 \geq 0.9998$) for at least 15 d after filling,

being approximately 170 mg SF₆/d at 39°C. There was no correlation between daily weight loss and time over the experimental period ($P > 0.05$). Comparison of slopes showed the rate of weight loss from the tubes estimated over days 1–5 and days 6–15 after manufacture did not differ ($P > 0.05$), although a decline in release rate by approximately 2% over days 6–15 suggested minor curvature in release rate existed. It is concluded that release rate can be derived from an initial 5 d calibration period prior to insertion into the rumen, but that monitoring of surveillance tubes for longer periods may be warranted if tubes are to be used for prolonged rumen studies.

Johnson, K., Huyler, M., Westberg, H., Lamb, B. and Zimmerman, P. (1994). Measurement of methane emissions from ruminant livestock using a SF₆ tracer technique. *Environmental Science and Technology* 28, 359–362.

Lassey, K.R., Walker, C.F., McMillan, A.M.S. and Ulyatt, M.J. (2001). On the performance of SF₆ permeation tubes used in determining methane emission from grazing livestock. *Chemosphere — Global Change Science* 3, 367–376.

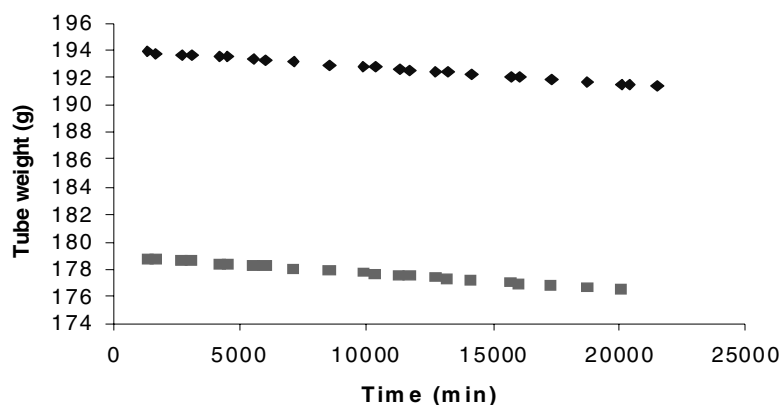


Figure 1 Weight of two high-flow permeation tubes incubated at 39°C after filling with SF₆.