Verification of airflow patterns and leakage of contaminants from fume cupboard

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One of the most important safety devices in a laboratory is the properly functioning fume cupboard. In the fume cupboard, hazardous chemicals released from experiments are drawn away from the worker and exhausted by fans. The performance of a fume cupboard is determined by a complex interaction of factors from the working chamber, the exhaust system, fume cupboard location, system indicators and operational parameters. The test methods used to judge the performance of a fume cupboard may include face velocity test, flow visualization and tracer gas test.

This article presents results of tests of influence of changes of airflow patterns and face velocities on the performance of different fume cupboards under given conditions and environment of use.

Table 1. Operational and measuring parameters.

Flow rate [m^3/h]	Face velocity [m/s]	Robustness [-]	Efficiency [%]
250	0.04	6	92.48
366	0.14	3	97.70
582	0.23	9	94.26
742	0.07	1	82.03

As a result, average values of the statement of volume of air flow in the exhaust duct, the face velocity, the robustness and the air exchange rate examined, it was found that the increase in the suction flow rate does not guarantee the increase of face velocity of fume cupboards and thereby increase its robustness level and the efficiency (Table 1). An important parameter in this case is also a way of making the fume cupboard and shaping the airflow patterns in and around the fume cupboard.

Figure 1. Local and gross smoke visualisation.

Flow visualization tests demonstrate detailed flow patterns in different regions of the cupboard to qualitatively support the experimental results of the tracer gas measurements (Fig.1).

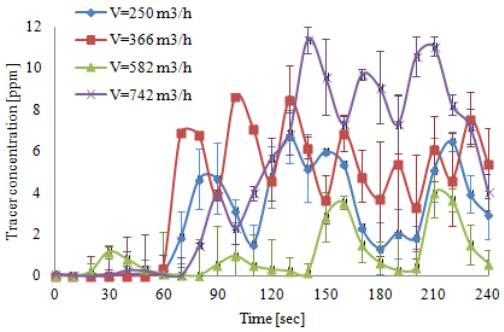

Figure 2. Distribution of SF_6 at robustness tests.

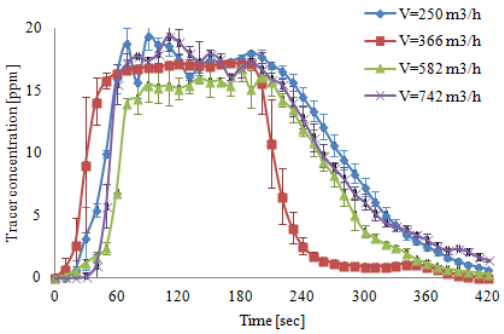

Figure 3. SF_6 distribution at purge measurements.

The overall concentration trend of contaminants along the face of the fume cupboard is obtained experimentally. Figure 2 and 3 shows the variability of concentration of SF_6 across the sash opening.

The airflow patterns and performance of the laboratory fume cupboard are closely correlated. The source position, geometric features and presence of an operator are important to the laboratory fume hood performance. The performance of the cupboard is strongly influenced by the ventilation system and other features of the laboratory in which it is installed.

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