How much is a “small” or a “minute” amount?

Biosafety cabinet standards and guidelines recommend using only "small" or even "minute" amounts of volatile flammable or toxic solvents in biosafety cabinets. Typical class II biosafety cabinets recirculate 70% of the air inside the cabinet by creating a stream of HEPA-filtered air down to the work surface (NSF-49:2012, EN 12128:2000). 30% are exhausted to the room or into the room exhaust ventilation system (canopy or thimble connection). The high internal recirculation of 70% raises concern that ethanol used for decontamination, for example, does evaporate and its concentration in the cabinet may reach the lower explosion limit of 3% (http://en.wikipedia.org/wiki/Flammability_limit#Examples). The flash point in air is 12.8°C! So are we at risk when we spray alcohol in a biosafety cabinet? How little ethanol is still safe?

Assuming the internal volume of a 1.5m wide cabinet is around 1000 liters (including all plenum spaces), 3% is 30 liters of gaseous ethanol. This is 1.22 moles (24.5 liters of a gas is 1 mole at room temperature). Ethanol’s mole mass is 46g/mole. From this the maximum amount of ethanol can be calculated as 56g or 70ml of 100% ethanol, or as 100ml of 70% ethanol. Now this is the static calculation, but inside the cabinet, the situation is dynamic, because the air exchange rate is very high, in the order of 15 per minute.

The air exchange rate can be calculated from the inflow of room air at 0.5 m/sec through the front opening of about 0.4 sq.m., obtaining an inflow of 12 cubic meters per minute. An air exchange rate or dilution rate of 12 per minute (remember, the cabinet’s volume is 1000 liters) means that in our example of ethanol usage an initial concentration is diluted very quickly to insignificant concentrations (calculated as a dilution or wash out function, which is an e-function).

While usage of "small" amounts in the order of 100ml 70% ethanol over a timespan of, say, 10 minutes is not a problem, larger spills in shorter timespans must be avoided. If the canopy exhausts into the room, ethanol gets diluted very much in the laboratory and does not result in an exposure or fire situation. However, if the volatile hazmat is toxic, recommended exposure limits need to be observed.

All the same, usage of alcohol as a decontaminant is problematic, because the laboratorian must insure sufficient contact time, which may require using large amounts of ethanol in a short timespan.

For a video on BSC decontamination see: http://www.youtube.com/watch?v=NgQxOwcOXE0

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