Carpet

A carpet lies in an empty room. The carpet emits a volatile chemical. The carpet weighs 200 kg and the room has a volume of 50 m^3. The distribution coefficient at 25°C is $K_{carpet / air}$ = 10 000 (L_{air} / kg_{carpet}).

How often does the room need to be aired (by opening a window) to remove 50 % of the initially present volatiles from the carpet? Assume that (i) the entire air in the room is quickly and completely replaced by fresh air during airing, (ii) the temperature is constant at 25°C, and that (iii) the distribution of the volatile into the wall and the window is negligible, such that after each airing step re-equilibration between the air and the carpet occurs.

What would happen if the room was additionally equipped with armchairs, curtains, …? A qualitative answer suffices.

Help: First calculate which percentage (or fraction) of the compound is left after one aeration.

To do this you can use sheet A and substitute the water phase by the carpet phase. The different units (kg instead of L) will cancel in the calculations anyway so that this needs no further attention. Or you can use sheet C (where the units of the organic phase are in kg already. You would then choose a zero-volume for air and treat the water phase as if it was the gas phase, i.e. enter the air volume for the water volume and enter the organic phase/air partition coefficient in place of the organic phase/water partition coefficient (in this case the K_{aw} will not matter any more). The organic carbon is assumed to be identical with the carpet material (fraction organic carbon is set = 1). If this information does not help you, then do the calculation by hand using the equation in the subchapter What is the use of knowing f_{r2} ?. Afterwards it might become clearer to you how the spreadsheet could have been used.

Answer: After one aeration 97.4% of the initially present volatiles from the carpet are left. When the room was aired 27 times (0.974^{27} = 0.49) the aim to remove 50 % of the initially present volatiles is achieved. See Carpet 0510.pdf for an example how this could have been calculated with the spreadsheet C.

Curtains and furniture would also sorb the pollutant to some degree. Hence, the equilibrium air

▶ Excercises for an improved intuitive understanding
▶ Questions for recapitulation
● Good to know
▶ Minesweeper-problems

concentration would be even smaller than in the above scenario requiring even more aeration cycles for the intented cleaning.