



Adsorption of High Concentrations of Organic Vapours on Activated Carbon

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This application note therefore describes how a standard DVS gravimetric flow adsorption system may be used to study the adsorption of organic vapours at high concentrations on activated carbons and other porous solid substrates..

Introduction

The study of adsorption of organic vapours on activated carbon substrates is of importance in many areas within the chemical industry. The adsorption of organic vapours at low partial pressures is best studied in a dynamic vacuum adsorption system [1], however at high partial pressures such instruments become less suitable due to the long pump down and equilibration times required. The adsorption characteristics of activated carbons at high solvent concentrations are particularly pertinent to environmental cleaning processes such as solvent recovery.

Method

The sorption isotherm for methanol on an activated carbon substrate was measured using a DVS automated gravimetric sorption analyser. The humidity probes in this instrument were removed and replaced with sealing blanks to protect them from irreversible damage due to the organic vapours, and the vapour outlet was exhausted to a fume extractor due to safety considerations. The substrate was initially dried by flowing under dry nitrogen, and the relative partial pressures of methanol were generated by mixing dry and saturated vapour gas flows in a

similar manner to the water vapour sorption experiments.

Results

Figure 1 shows the methanol sorption kinetics on an activated carbon sample at 25°C. The amount of methanol sorbed is expressed as a percentage of the mass of the activated carbon sample after the drying cycle and the partial pressure of methanol as a percentage of the saturation vapour pressure of methanol at 25°C.

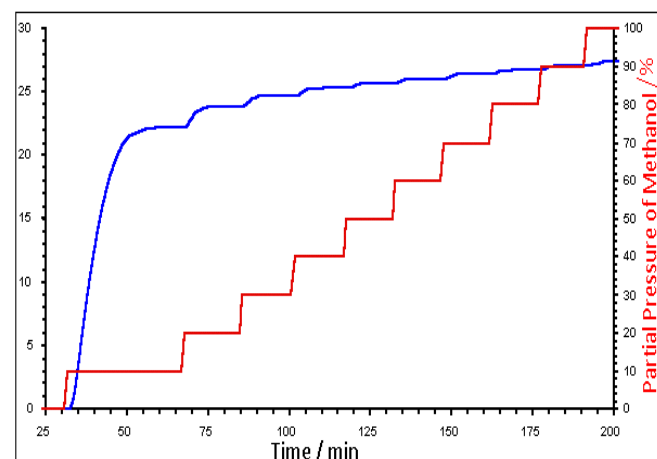


Figure 1. Kinetics of sorption of methanol on activated carbon at 25°C.





For each sorption step, the sample was allowed to reach equilibrium before proceeding to the next step. This data demonstrates the speed of the flowing gas technique at relatively high partial pressures of methanol - the whole sorption isotherm was measured in less than 4 hours.

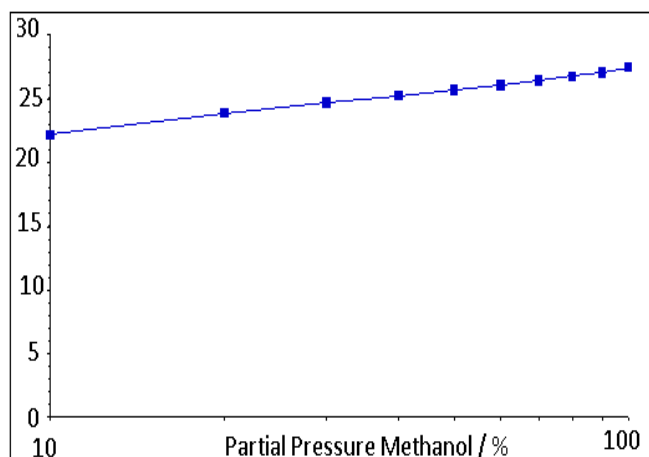


Figure 2. Sorption isotherm for methanol on activated carbon.

Figure 2 shows the sorption isotherm for methanol on activated carbon at 25°C. It is clear that the largest uptake of methanol (~ 22%) occurs below the first sorption step at 10% partial pressure. The data is plotted on a logarithmic partial pressure axis demonstrating that the isotherm shows type I behaviour in this regime and is typical of adsorption isotherms measured by other techniques [2].

Conclusion

The adsorption of organic vapours on activated carbon may be readily studied using a DVS dynamic vapour sorption instrument with minor modifications. The flowing gas technique is best suited to relatively high partial pressures of vapour, where sorption kinetics are fast.

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References

- [1]C.L. Levoguer, Dynamic Vapour Sorption Application Note, 06.
- [2]R.C. Bansal, J. Donnet, F. Stoeckli, *Active Carbon*, Marcel Dekker, 1988.

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