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Watching paint dry – Monitoring emissions of VOC and oVOCs

Kevin P. Wyche, Robert S. Blake, Christopher Whyte, Andrew M. Ellis and Paul S. Monks

Department of Chemistry, University of Leicester, Leicester, UK

(p.s.monks@le.ac.uk / Phone: +44-116-252-2141)

In modern society, human beings are spending more and more of their lives in the indoor environment; indeed it is where the most vulnerable members of the population spend the vast majority of their time, such as the very young and elderly at home or the sick and infirm in hospital. Following this trend we are becoming increasingly concerned about the quality of our indoor air, particularly when modern energy saving trends are leading to lower ventilation rates in buildings and now that various new furnishing techniques are being brought into the home. Of the diverse sources of atmospheric pollution indoors, the emission of volatile organic compounds (VOCs) from paint as it dries can be one of the most major.

Modern paint consists primarily of a pigment and a binder carried by a solvent. Typical solvents used in commercial paints range from white spirit to water and their evaporation following application is paramount to the drying process in the early stages. It is generally the type and nature of the solvent that helps to determine the classification of the paint as a high, mid or low VOC emitter. Conventional solvents such as white spirit, typically used in gloss paints, consist of highly volatile species which readily evaporate on application, yielding large quantities of gaseous VOCs to the atmosphere. At the opposite end of the emissions spectrum, modern low VOC paints (commonly employed in schools and hospitals, (Chang *et al.*, Indoor Air, **12:** 10–16, 2002)) are water based, with VOC emissions primarily originating from various additives (Gebhard, Macromol. Symp. **187**, 771–780, 2002). The typical VOCs emitted into our indoor atmosphere following the application of paint are known to be responsible for a wide range of adverse health effects, particularly in vulnerable individuals.

For the first time, “real-time” monitoring (ca. 30 seconds) of the evolution of VOC emissions from drying paint has been achieved. Utilising the University of Leicester Chemical Ionisation Reaction Time-of-Flight Mass Spectrometer (CIR-TOF-MS), the entire mass spectra from the emissions of a number typical commercial paints have been captured on-line during the initial 8 hours of the drying process. Utilizing hydronium ions (H_3O^+) to protonate the sample, VOC sensitivities of the order 0.1 counts ppb^{-1} s^{-1} are obtained. The results derived from this work not only give insight into the type and quantity of VOCs found in the atmosphere above drying paint films, but provide key information on the various drying stages of the paint through emissions monitoring. This provides important information regarding levels of exposure during and after application. Results also reveal the effect that variation of local atmospheric temperature and humidity has on the drying process and hence the loading of indoor levels of atmospheric pollutants.

This work provides vital information on how paint can be applied in the indoor environment to limit exposure to potentially harmful VOCs and opens up new opportunities to paint developers for the production of “smart paints”.