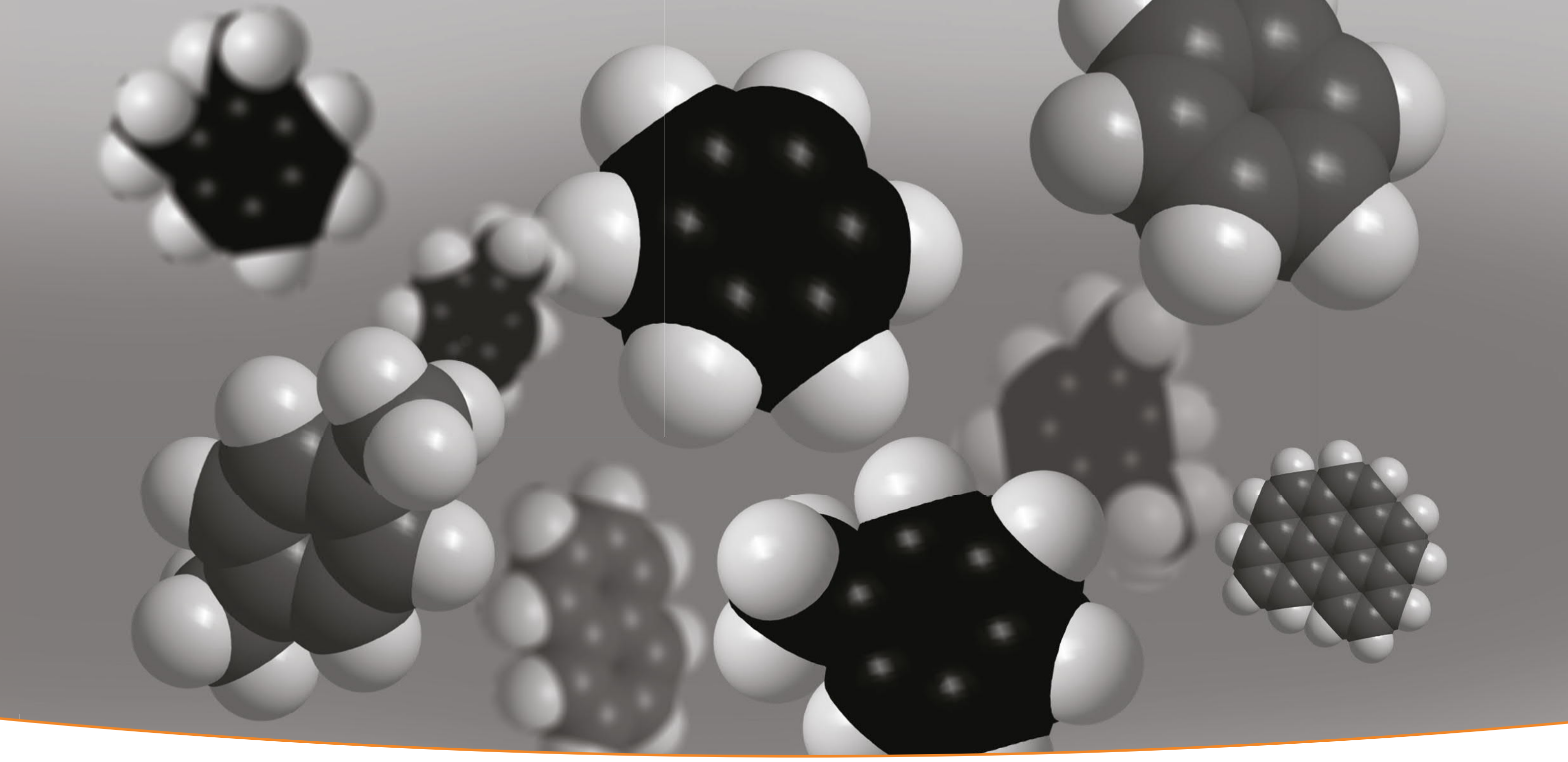

Determining the efficiency of decorative depolluting materials

Method development to test the efficiency of indoor depolluting materials

Executive Summary

Often indoor air is considered more polluted than the outdoor air as the concentration of harmful or poisonous compounds is usually higher. Decorative materials reducing the pollution can improve indoor air quality. The benefits of such developments can be enormous.
Nevertheless, reliable measurement of the efficiency of the depolluting effect is still a significant challenge. This White Paper shows how analytical scientists in Nouryon Expert Capability Center Deventer (ECCD) have developed methods to test the efficiency of indoor depolluting materials.

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>10000	Samples Analyzed per year

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Determining the depolluting efficiency of indoor decorative materials

The conventional method to measure indoor depolluting efficiency is a static head space method. In this method a small sample is placed in a 20 mL tube and exposed to the injected test gas. After some time-interval the gas composition in the headspace is measured by gas chromatography (GC). The method is not accurate, is highly labor intensive, time consuming and low in reliability. Analytical scientists in ECCD have developed a more sophisticated, real time, fully automated methodology to measure the efficiency of depolluting materials in indoor applications, which is more representative of real-world conditions.

How to develop a technique to measure depolluting efficiency of decorative materials

1) Identification of the chemical/physical characteristics of the air pollutants and the technology of the indoor depollution material.

For indoor depolluting applications, toluene was chosen as the air polluting reference compound. The experimental technology under evaluation was a mixture of various adsorbents incorporated in the formulations. The underlying support for the client's product development was to measure the depolluting efficiency in different formulation mixtures of the various types and amounts of adsorbents.

2) How to choose the right analytical method?

As indoor air polluting components are organic compounds the best way to measure them would be using GC.

To increase the measurement frequency an ultra-fast GC system has been chosen which could receive a gas injection every five minutes.

3) How to carry out the analyses?

The toluene test component concentrations were set to 200 and 50 mg/L in air as determined by GC.

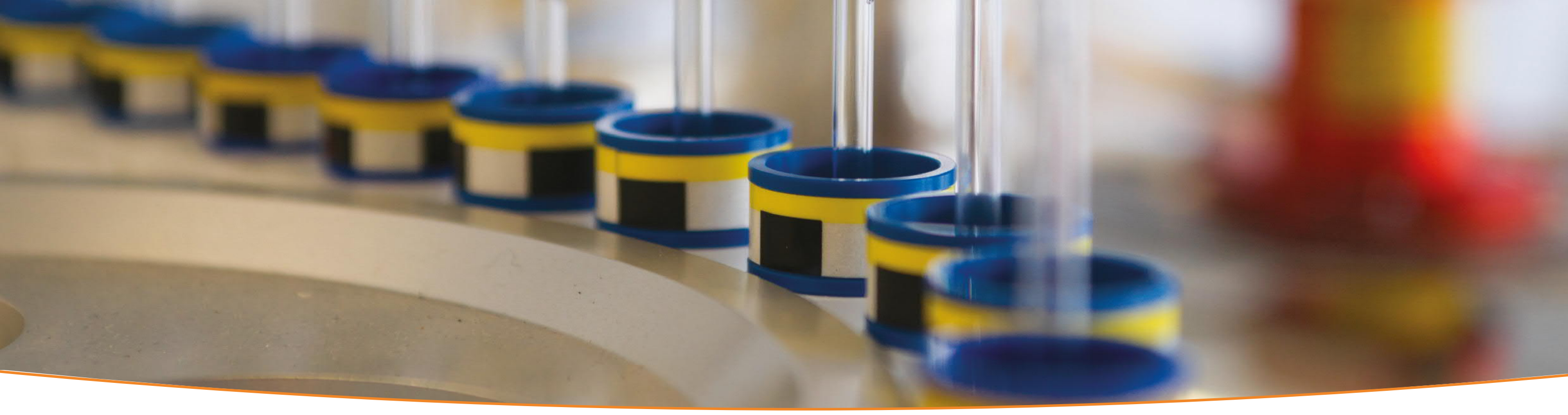
The test procedure consisted of a 24hr absorption test in a device called exposure chamber (Figure 1) with a gas flow of 200 mg/L toluene in air at a speed of 10 mL/min. The air was enriched by toluene using a permeation device (Figure 1).

This was followed by a 24hr desorption test with clean air.

Automatic sampling took place every five minutes. The air flow coming from the exposure chamber was directly connected to the gas sampling valve of the GC system (Figure 2). The GC system and sampling valve were under direct software control to run unattended.

Figure 1: Adsorption test set-up consisting of glass exposure chamber and permeation device (yellow tube)

Figure 2: GC system with gas injection valve



The GC system was calibrated by a multilevel external calibration. In total 50,000 measurements have been carried out with this setup. Two different approaches were employed.

Test method-1.

Following the adsorption stage the samples were removed from the test chamber to allow rapid flushing to rapidly to reduce the chamber toluene concentration to zero (Figure3).

Test method-2.

After the same adsorption stage as in method-1 an improvement was developed avoiding sample removal and flushing steps ensuring no loss of toluene prior to the desorption stage (Figure 4).

A clear difference in adsorption capacity was observed and the best performing material could be selected. In this example the best performing material had the higher % adsorbent showing the least amount of toluene in air.

When desorption was tested it became clear that removing the sample and storing it during the chamber flushing had a strong influence on the curve shape and the comparison of the desorption capacity (figure 3b and 4b).

However, the trend observed for different adsorbent concentration levels was the same making method-2 suitable for screening purpose.

The decorative materials with strong adsorption presented the strongest desorption confirming the reliability of the chosen method.

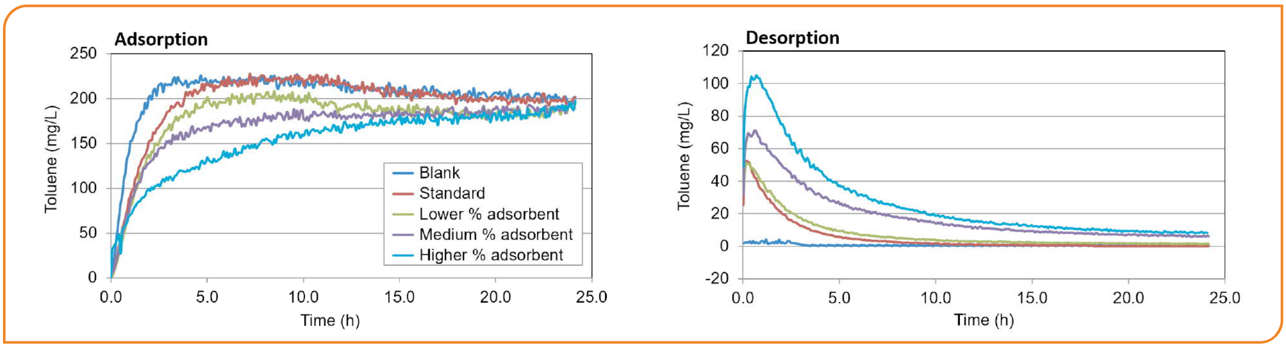


Figure 3: Example adsorption and desorption results using test method-1

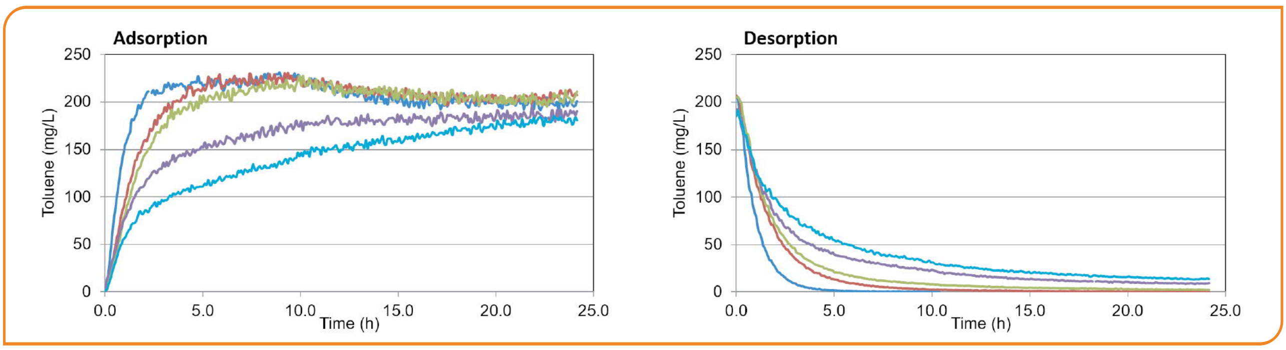


Figure 4: Example adsorption and desorption results using improved test method-2

Conclusion

The conventional method for measurement of depolluting efficiency was time-consuming and neither accurate nor reliable. The ECCD was successful in developing an alternative approach delivering depollution efficiency measurement for indoor applications in real-time, fully automated and reproducible.

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