INTRODUCTION

Emissions from vehicle trim components (PVC, polyurethane, foam, carpets, adhesives etc.) can adversely affect vehicle interior air quality (VIAQ), and subsequently the comfort and health of drivers and passengers.

As a result of these concerns, VIAQ is of growing importance to the automotive industry, mainly due to market image but ever more due to the increase of industry regulation. This has been reflected in the development of harmonised methods to quantitate releases of chemicals released from the materials used, and assess the overall quality of in-vehicle air.

METHODS & REGULATIONS

Using these methods, the emission levels and potential impact of any given car trim component can be evaluated, and the levels of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs, i.e. fogging compounds) and specific malodorous compounds emitted under different conditions can be determined.

Target compounds include formaldehyde, acetaldehyde, benzene, styrene, xylenes and phthalates, and limit levels are specified by various automobile associations, including:

- Japan Automobile Manufacturers Association (JAMA).
- European Automotive Manufacturers’ Association (ACEA).
- Global Automakers, formerly the Association of International Automobile Manufacturers (AIAM).
- Labelling organisations (e.g. TÜV Rhineland Group).

Over the years, hundreds of manufacturer-specific methods have been developed for the sampling and analysis of VOCs and SVOCs, and these employ numerous analytical techniques.

Some widely-used methods are:

- General Motors GMW15654: Full vehicle air sampling, VOC and SVOC analysis by GCMS.
• General Motors GMW15634: Interior materials VOC and SVOC by TD-GCMS (direct sampling) thermodesorption.
• BMW GS97014-3: Emission measurements with air exchange in a testing chamber.
• Volkswagen PB VWL 709: Analysis of the emission of volatile and condensable substances from vehicle interior materials by thermodesorption.
• VDA 278: Thermal desorption analysis of organic emissions for the characterization of non-metallic materials for automobiles.
• TSM0508G: Volatile component measurement method using sampling bag.

Therefore, to simplify matters for the industry, the International Standards Organisation recently convened a technical committee (ISO/TC 146/SC 6) to develop harmonised methods. Four methods have been developed by ISO/TC 146/SC 6 for sampling VOCs and SVOCs from vehicle interiors and the materials used in them:

• ISO 12219-2: Interior air of road vehicles – Part 2: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Bag method.
• ISO 12219-3: Interior air of road vehicles – Part 3: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Micro-scale chamber method.
• ISO 12219-4: Interior air of road vehicles – Part 4: Method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Small chamber method.

Three further methods are in preparation:

• ISO/DIS 12219-5: Interior air of road vehicles – Part 5: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials – Static chamber method.
• ISO/AWI 12219-7: Interior air of road vehicles – Part 7: Odour determination in interior air of road vehicles and test chamber air of trim components by olfactory measurements.

SAMPLING TECHNIQUES

To determine emission profiles that are representative of real-life situations (including ‘worst-case’ scenarios if needed), three main techniques can be used:

Small chambers
Relevant methods are:

- VDA 276: Bestimmung organischer Emissionen aus Bauteilen für den Kfz-Innenraum mit einer 1m³-Prüfkammer).

The sample is placed in the chamber, which is held at a specified temperature as a flow of gas is applied. VOCs and SVOCs are collected onto a sorbent tubes for analysis by TD–GC–MS.

**Bag sampling**

The relevant method is:


The sample is placed in a large non-emitting plastic bag (e.g. made from Tedlar® or Mylar®), a gas is applied and the bag sealed. After a period of incubation, the static headspace is then pumped out of the bag onto a sorbent-packed TD tube for analysis by TD–GC–MS.

**Microchambers**

Relevant methods are:

- ASTM D7706: Standard practice for rapid screening of VOC emissions from products using micro-scale chambers.

The sample is placed in one of the compact chambers, which is held at a specified temperature as a flow of gas is applied. Analytes are collected onto a sorbent-packed TD tube for analysis by TD–GC–MS.

Small-chamber methods are typically used for product certification, but the tests can be time-consuming and can be expensive. Bag sampling is particularly popular in Asia, and although quicker than small-chamber certification methods, is compromised by the tendency of SVOCs to ‘stick’ to the inside of the bag (‘wall effects’).

Microchambers help solve these issues, by handling a wider analyte range than bag sampling while being small enough to allow rapid sampling. In addition, because they use the same extraction technique as small chambers, emissions data from rapid microchamber screening can be correlated with that from small chambers, allowing users to predict the outcome of longer-term certification tests. As a result, microchambers are now recognised as an ideal method for emissions screening and quality control.
Surface and bulk emissions

Recent studies on the preparation of materials for micro-scale chamber analysis have shown the relation between surface and bulk emissions and the relevance when applying limit levels and regulatory values.¹

CORRELATION OF METHODS

Studies carried out by SAE International (Society of Automotive Engineers) and Prof Mangoo Kim of Kongwon National University Korea will be presented showing the correlation of the sampling methods and the criteria set by varying national bodies.²,³

CONCLUSION

Micro scale chambers used for sampling automotive trim materials for the emissions of VOC and SVOC allows manufactures to understand the properties of their material. As well as this it enables (SV)OC emission screening for routine quality control, evaluating prototype ‘low-emission’ materials/products during development, monitors product uniformity/conformity between formal certification tests, compares emissions from products within a range (e.g. different colours/patterns), checks the quality of raw materials and facilitates troubleshooting customer complaints. Studies show that the ability to test surface and bulk emissions simultaneously gives the manufacturer valuable information on which component of their products cause greater concentrations of compounds to be emitted. This in turn can be looked at on a larger scale of differing countries and which sampling method is most suitable for differing sections of the certification process, resulting in better VIAQ for all.

REFERENCES