Examining the Unique Challenges of VOC in Automotive Interiors

What's driving the future of headliners and other components?

People around the world have become familiar with the importance of air quality. Along with that, we've heard a lot about volatile organic compounds, or VOCs. VOCs are carbon-based compounds. We become exposed to VOCs when they vaporize into the air, and they generally vaporize more quickly under elevated temperatures. Not all VOCs are harmful, but among those that can be are toluene and formaldehyde.

Most of us have come to associate VOCs with air pollution – commonly known as smog – and with off-gassing from materials used for new or refurbished houses. We are perhaps most familiar with them as by-products of the combustion of fuels or from materials used in building and construction, such as plastic and leather.

VOCs and the Automobile: A New Area of Study

It should be no surprise, then, that an important area that is steadily emerging as a concern for air quality is the interior of automobiles worldwide. This is due to several overriding factors – emerging trends such as ride sharing and autonomous vehicles are increasing the value and importance of the entire experience of a vehicle's interior.

In particular, the growth of the automobile industry in Asia is a tremendous driver of vehicle interior air quality, or VIAQ. Research shows that off-gassing, or chemicals emitting from vehicle interior materials such as plastics, fabrics, resins and polymers, is a growing concern – one that creates an opportunity for manufacturers and suppliers of these components.

VOCs are inherently present in newly produced components for auto interiors, which are made of materials like rubber, plastic, foam and leather. They contain additives that are especially volatile – they vaporize into the interior, creating odors and fogging – when vehicles are new. Reducing these vaporized chemicals, and increasing customer appeal at point of sale, is a clear opportunity for automotive engineers.

According to UL, which published a white paper on VIAQ, "numerous studies have found the measurable presence of anywhere from 30 to more than 250 separate VOCs in a single vehicle, in total concentrations as high as 14,000 µg/m3."

Since temperature is a big factor in VOC emissions, VOCs can begin outgassing even once the vehicle ages if it gets too hot inside. This is especially relevant in light of a recent study by the American Automobile Association, which shows that US commuters spend an average of 293.3 hours per year inside their vehicles.

Where Concern for VIAQ is Highest

Though there are many other government regulations in other regions, China has been the source of the most current discussions worldwide about standards for VOCs inside vehicle cabins. In particular, the Chinese government, through its GB ("Guobiao", Chinese for "National Standard"), is placing increasingly strict regulations on the level of VOCs that can be present inside the cabin of an automobile. In 2011 it published a guideline for "Air quality assessment of passenger car" (GB/T 27630-2011) which included testing methods as well as maximum values for odor emission of materials within the vehicle interior such as plastics, textiles or rubber. In 2015, it revised the guideline again; in 2017, it signaled that it would replace the voluntary guideline with a stricter standard by 2020 to include up to 13 harmful substances including toluene, xylene, ethylbenzene, styrene, formaldehyde, acetaldehyde and acrolein.

It's common to measure VOCs by heating the test materials, which accelerates vaporization and allows for measurement in minutes instead of days. The heated gas is forced though a column which separates the molecules to produce an accurate measurement of each chemical including formaldehyde and especially acetaldehyde. This ability is important: in Asia, which has consistently led worldwide growth in new automobile manufacturing, aldehydes are an immediate concern for government regulators, OEMs and suppliers of automotive interior materials.

This should be a wake-up call for suppliers selling vehicles to Asian markets, and for those hoping to meet worldwide standards.

This is not to say that the rest of the world is turning a blind eye. Japan formulated a standard for 13 VOCs in 2005 according to its JAMA standards, and Korea published a notification for new vehicles in 2007 that covers seven substances.

VOCs in Europe

In Europe, the European Automobile Manufacturers Association (ACEA) is very focused on air quality. Together with standards developed and promoted by individual European national organizations such as Germany's Verband der Automobilindustrie (VDA), which publishes its VDA 278 test method, western Europe is an emerging leader in VIAQ inside the vehicle as well.

For its part, the International Organization for Standardization (ISO) has prepared a draft of standards and test methods – ISO 12219 – intended to harmonize the efforts of multiple nations worldwide. The document deals entirely with the interior air of road vehicles, and includes the specification and multiple methods for determining the levels of volatile organic compounds in vehicle cabins.

A Focus on Headliners

As auto trends clearly create demand for lower VOCs in automotive interiors, identifying technologies and incorporating products is a growing challenge for OEM material and design engineers as well as their suppliers.

A good place to start: The headliner. This critical part of the interior makes particular sense simply because of its location – just above the occupants' heads. It is also a rapidly evolving component;

leading manufacturers are responding to new demands in design and low VOC requirements with modular headliners made from a continually expanding range of new materials.

Far from a simple shaped fiberboard, these modular headliners are designed to incorporate multiple panoramic sunroofs, custom lighting, loudspeakers, antennas, wiring and wire harnesses, sun visors and more. They are also created from new materials – many of which are being modified to reduce VOCs during and after manufacturing.

Newer avenues for low-VOC headliners are thermoplastics and thermosets. Thermoplastics melt when heated, making them relatively easy to convert and modify. However, thermoplastics must sometimes be made more flexible using plasticizers – often the source of that "new car smell" which is a disqualifier in much of Asia. Thermosets are permanent solids, but some of them release chemicals left over from the manufacturing process.

Headliners and Adhesives

Adhesives are often used to incorporate these materials. Manufacturers of automotive adhesives are often faced with two challenges: the adhesive must be designed to bond to new, often low-surface-energy materials, and they should not be a major source of VOCs.

Manufacturers worldwide are embarking on long-term sustainability efforts, both for the manufacturing process and for the performance of finished products. Specifically, manufacturers of single-and double-sided bonding tapes, transfer tapes and hot melt adhesives must continue to invest in and commercialize products that meet varied and continually evolving automotive industry standards. For its part, 3M has commercialized tapes that meet EU and Japanese low-VOC standards, ideal for the automotive interior space.

Other low-VOC 3M products include a range of water-based and low-VOC spray adhesives – excellent for headliner application – including 3M™ Fast Tack Water Based Adhesive 1000NF, formulated for bonding materials such as flexible and latex foams, fabric, polyester fiberfill and many plastic and metal surfaces. 3M also supplies a range of traditional and sprayable hot melt adhesives.

A Changing Landscape

As interior design flexibility becomes more important with the advent of autonomous vehicles and ride sharing, suppliers and manufacturers throughout the supply chain will need to become more aware of rapidly-changing performance criteria. Limiting volatile organic compounds in the interior is just a part of it. But it is a part that will become more and more important in the near future.

Increasing government regulations around interior cabin air quality in passenger vehicles – and as a result, more stringent automotive OEM standards – are driving the need for the next generation of low VOC components and adhesives. The entire automotive value chain will be impacted by these new requirements. 3M is well positioned to help advance the quest for lower emissions, while enabling greater design flexibility and freedom.

Sources:

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