



Innovations in Auto Air Quality: Low VOC Automotive Adhesives

Abstract:

Is the U.S. falling behind in automobile interior air quality safety? That “new car smell” that’s as much a status symbol as it is a characteristic of brand new vehicles is actually a toxic blend of volatile organic compounds (VOCs). Both Asia and Europe have started to put regulations in place to reduce the toxicity of automobile interiors and use their low-VOC innovations as a selling point, leaving the U.S. market behind in both health and environmental concerns.

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Introduction: A Toxic Tale

The instantly-recognizable “new car smell” that American consumers seem to love is actually evidence of a cocktail of chemicals, known as volatile organic compounds (VOCs), including such dangerous chemicals as formaldehyde and styrene, off-gassing into the air inside cars. The compounds are emitted from the materials used in manufacturing, such as textile treatments, plastics, sealants, lubricants, and finishes, as well as the adhesives used to bond the majority of the materials in the car, inside and out.

While studies have shown an average of 50 to 100 different VOCs in car interiors, it is suspected that they can contain upwards of a thousand individual VOCs, each posing a serious health risk to drivers and passengers. Due to low boiling points, these compounds release a massive amount of molecules into the air, even at room temperature, and the problem is only exacerbated in extreme heat. In fact, a parked car in the summertime can have as many as 5x higher total volatile organic compound levels (TVOCs) than during average daytime temperatures.

The World Health Organization has recognized that air quality inside cars is a “major concern for human health.” Even after the “new car smell” fades, toxicity levels can remain high enough to exceed standards for indoor air quality established for buildings and pose a significant health risk to occupants.

While there are no regulations in the United States for automobile indoor air quality, some manufacturers are beginning to choose low-VOC automobile adhesives and materials as more information emerges about the toxicity of the “new car smell” and the dangerous VOCs and polybrominated diphenyl ether (PBDEs) associated with it.

The Problem: Risk vs. Efficiency

Concerns over human health

It's clear that the biggest concern about automobile adhesives is the human health risks associated with exposure to the VOCs the adhesives produce. According to Jeff Gearheart, Research Director at Ecology Center, Americans spend an average of 1.5 hours in cars each day. "Since these chemicals are not regulated," he said, "consumers have no way of knowing the dangers they face." The longer amount of time spent in the car, the higher the exposure is and the greater the health risk. To put it into perspective, the exposure to volatile organic compounds in a single 90-minute drive in a new car is equivalent to 8 hours of exposure to indoor toxins in an office.

Several studies have shown high enough TVOC levels in new car interiors to produce immediate symptoms in some occupants, including headache, respiratory irritation, and vomiting. Long-term health risks associated with high levels of VOCs include cancer, birth defects, and infertility, as well as damage to organs and the central nervous system. In fact, a large number of VOCs found in cars are known or suspected carcinogens.




Some will argue that VOCs only pose a danger in the first few months, and consumers do not need to worry about long-term risks. It's true that the concentrations of VOCs in cars drop significantly over time. A study conducted by GREENGUARD showed an average TVOC reduction of approximately 20 percent per month, and researchers at Australia's Commonwealth Scientific and Industrial Research Organization, who measured concentrations in new cars from the purchase date to roughly two years later, saw levels drop seven fold in the first month alone. In general, toxins reduced to safe levels of 0.5 mg/m³ by 6 months.

The study, however, also showed a spike to unsafe levels again in extreme heat even years later, indicating that consumers are at risk during daytime hours and summer months throughout the lifetime of the vehicle. Add to that VOC "pools," which are areas in the car

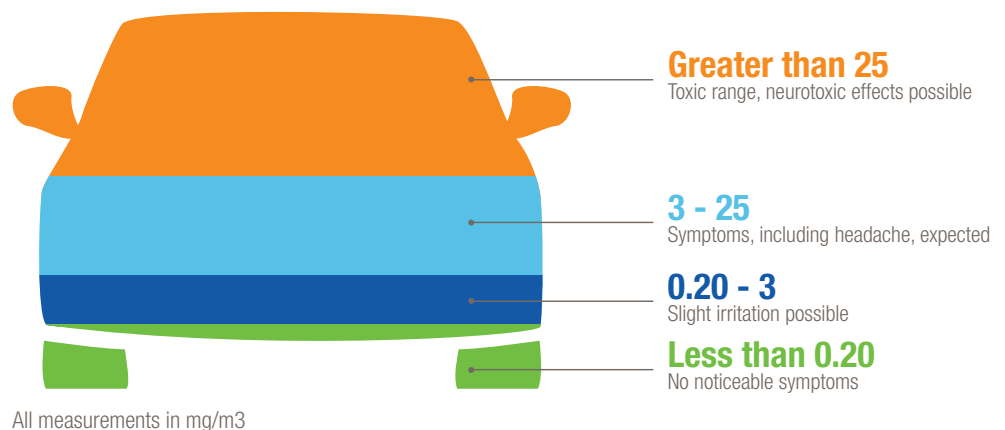
where off-gassed compounds settle and pose an additional long-term risk. A study by the Ecology Center showed that PBDE and phthalate levels were 10x higher in windshield film and 5x higher in dust than the average for homes and offices.

It's important to note that VOCs pose a serious environmental impact as well. When VOCs escape car interiors, they can form ground-level ozone when they chemically interact with

The Hidden Dangers

		
<p>Common dangerous compounds in cars</p> <ul style="list-style-type: none"> • benzene • cyclohexanone • xylene • formaldehyde • toluene • styrene • ethylbenzene • arsenic • chlorine • lead • heavy metals • phthalates • polyvinyl chloride (PVC) • bromine 	<p>Acute short-term symptoms</p> <ul style="list-style-type: none"> • headache • dizziness • blurred vision • disorientation • eye irritation • nose and throat irritation • asthmatic response • allergic response • respiratory irritation • fatigue • mental confusion • nausea • vomiting 	<p>Chronic long-term health risks</p> <ul style="list-style-type: none"> • cancer • birth defects • learning disabilities • infertility • liver damage • kidney damage • central nervous system damage

How Much is Too Much?

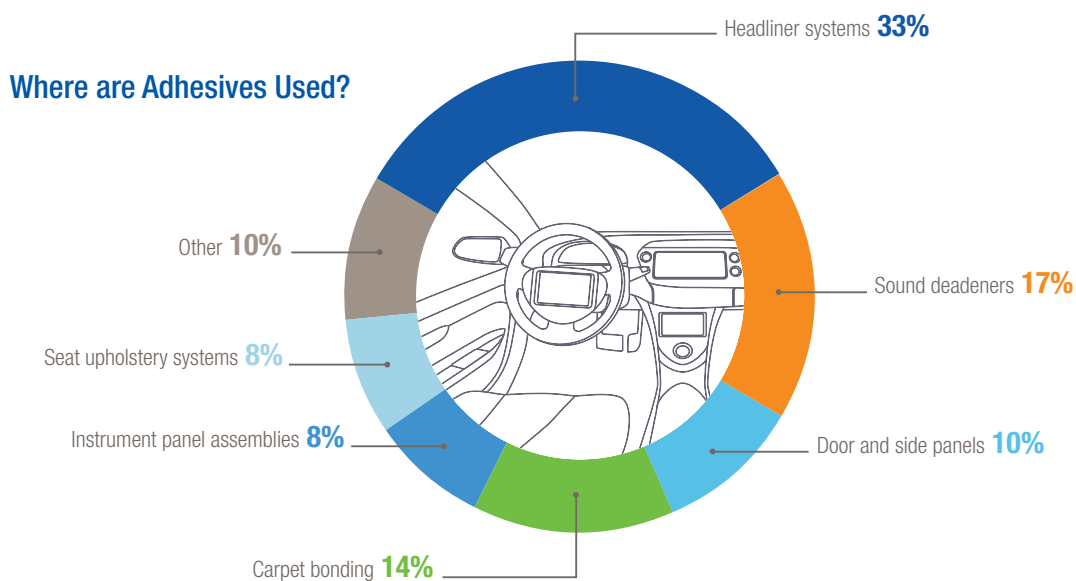


oxides of nitrogen and sunlight, which can significantly affect crops and vegetation as well as contribute to air pollution. This indicates that simply “airing out” a vehicle, as consumers are instructed to do for the first 6 months of ownership, does not eliminate the harmful effects of VOCs.

The Need for Adhesives

Balanced against the documented health hazards and environmental effects is the obvious need to use adhesives in modern car manufacturing. Auto adhesives are employed as primary bonding methods in most major car interior components and installations, including headliners, door panels, interior pillars, instrument panels, seating, duct work, and carpets. To illustrate the volume of adhesives used, consider that approximately 96 million dry pounds of adhesive were used in auto interiors in North America in 2001 alone. Those auto adhesives are essential to allowing car manufacturers to reduce costs, manpower, and time while providing improved operation, safety, and aesthetics.

Take, for example, the approximately 5,000 welding points found in a conventional mid-sized sedan. By replacing just half of those with adhesive bonds, the manufacturer saves money, reduces the overall weight of the vehicle, cuts manufacturing time, and creates a stronger, safer bond.



Hot melt adhesives, as another example, cool incredibly quickly, allowing the next adhesive application to take place immediately. This has significantly reduced both production time and manufacturing costs overall as well as provided a viable way to bond dissimilar substrates. The adhesion of various weights, textures, and constructions of materials is one of the primary reasons adhesives are used in car interiors. Bonding lightweight materials was impossible before the invention of auto adhesives, and attaching carpets, headliners, and door trimmings are made not only possible, but easy, time-efficient, and cost-effective by adhesives.

Automobile adhesives have revolutionized the way cars are built, inside and out. They provide stronger bonds, invisible bonding, even distribution of bond stress, ability to join dissimilar substrates and surfaces, fill gaps, and reduce noise while they eliminate bond failure due to vibration and corrosion.

The Solution: A Way Forward

Several countries have already implemented strict standards regulating the total volatile organic compound levels (TVOCs) in automobile interiors. In contrast to the American market, where the “new car smell” is as much a status symbol as it is an indicator of dangerous chemicals, consumers in Japan refuse to purchase any car with a noticeable odor. In fact, many countries throughout Asia and Europe have been manufacturing low-VOC cars for quite some time, both in an effort to meet strict regulations and consumer demands.

Japan has lead the way in reducing VOCs in auto interiors. They've cut 13 VOCs, including styrene and formaldehyde. Toyota, Nissan, Honda, Mitsubishi, and Mazda have taken steps to significantly reduce TVOCs and already have cars on the market in Asia that comply

with regulations, many of them focusing on low-VOC automobile adhesives to help them meet standards. In fact, Mazda was able to meet regulations by switching to low-VOC adhesives alone.

The move towards reducing and eliminating VOCs in car interiors has led to significant improvements in auto adhesives. The results of more water-based liquid adhesives that reduce VOC evaporation, known as “fogging,” which is most noticeable as a white film on the interior of windshields, than their solvent-based counterparts. Low-VOC initiatives have also seen a growth in popularity of hot melt solid adhesives, which are known to significantly reduce, if not eliminate, VOCs, and also offer improved performance, reduced manufacturing times, and cleaner applications than liquid adhesives.

5 Ways to Reduce Adhesive VOCs



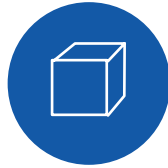
1

Eliminate solvent-based adhesives where possible.



2

Use water-based or liquid-based formulas.



3

Choose solid adhesives, such as hot melts, over liquids when possible.



4

Focus first on areas of the interior with high levels of adhesive, such as headliners and sound deadeners.



5

Choose adhesives with good heat performance to reduce emissions during hot weather.

H.B. Fuller is the industry's leading supplier for laminate adhesives and are now leading the way in auto adhesive innovations. They are dedicated to reducing and eventually eliminating VOCs in auto adhesives used in car interiors. Their industry-leading adhesives have already been used in cars manufactured in the Americas, Europe, and Asia Pacific. Their water-based and solid adhesives offer short cooling times, low activation temperatures, short cycle times, heat and hydrolysis resistance, superior bonding strength, and adhesion across a broad range of substrates.

Conclusion:

While data varies among studies, results consistently show the serious dangers associated with VOCs in auto interiors and the need for a solution to the toxic problem. Through low-VOC auto adhesive applications, volatile organic compound emissions can be significantly reduced in car interiors, keeping consumers safe while still maintaining the integrity of structural and installation bonds.

For manufacturers who wish to reduce the concentration of toxic compounds found in their cars, H.B. Fuller has formulated low-VOC automobile adhesives already applied to cars manufactured in Asia Pacific and Europe to help manufacturers meet strict regional regulations and use low-VOC interiors as a selling point.

H.B. Fuller's team of experts offer tailored solutions to meet each client's individual needs. Even the most challenging applications have low-VOC solutions that can be custom-designed to meet the strictest standards.

Additional Resources:

http://greenguard.org/Libraries/GG_Documents/Reformat_Indoor_Air_Quality_Hazards_of_New_Cars_1.sflb.ashx

<http://www.compoundchem.com/2014/06/16/newcarsmell/>

<http://www.cnn.com/2008/LIVING/wayoflife/10/24/aa.toxic.cars/>

<http://www.alternet.org/new-car-smell-killing-you>

<http://www.ecocenter.org/article/news-ecolink-press-releases/new-ecology-center-guide-toxic-chemicals-cars-helps-consumers>

<http://www.azonano.com/article.aspx?ArticleID=1599>

http://www.chemquest.com/PDF-files/Adhesives_in_Automotive_Interiors.pdf

<http://www.epa.gov/iaq/voc.html>

<http://www.environ.ie/en/Environment/Atmosphere/AirQuality/VolatileOrganicCompounds/>



To learn more about safer automotive adhesive innovations and tip the scales on the low-VOC market, visit <http://www.hbfuller.com/north-america/contact-us>.

 Join the Conversation | www.hbfuller.com/connect

IMPORTANT: It is the user's responsibility to test and determine the suitability of a product for the user's intended use. Any product samples provided for testing are provided in accordance with standard limited warranties as stated on our technical data sheets.

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