Life might be a highway, and you might want to ride it all night long, but you probably want to crank the stereo and not listen to the rattles, shakes, and hums that vibration causes in your car when adequate noise mitigation methods haven’t been taken.

The World Health Organization lists noise pollution as second only to air pollution in the impact it has on health, since it is a major cause of stress, hearing loss, heart disease, and sleep disturbance. For car manufacturers, reducing these risks through noise, vibration, and harshness (NVH) control means reducing noise experienced while driving from external, environmental factors as well as noise produced within a car by its components. In essence, car manufacturers are tasked with ensuring drivers and passengers experience a quiet interior environment that matches their expectations and preferences.

The shift from body-on-frame to unibody construction in automotive manufacturing, along with recent auto industry growth and consumer demand for quiet interiors, have increased the need for noise reduction materials that help original equipment manufacturers (OEMs) achieve fast model redesigns and assembly line flexibility. Traditional noise-mitigating materials often need to be reproduced to align with new frame shapes and re-delivered coatings

Dow Coating Materials engineers say switching to liquid-applied acoustic coatings from bitumen pads can lower vehicle weights while improving noise, vibration, and harshness performance.

By Ray Somich and Justin Gimbal

Figure 1

Spray-on sound-deadening materials

Vibrating metal creates sound that contributes to unwanted noise.

LASD coating absorbs energy that causes vibration and noise.
Liquid-applied sound deadening (LASD) coatings can be applied on substrates in difficult-to-reach areas and at various thicknesses for optimized acoustic performance.

**LASD technology**

Built on water-based acrylic polymer technology, environmentally friendly LASD coatings reduce workers’ exposure to harmful emissions and work well for any vehicle that can benefit from sound management. The coatings’ versatility allows for strategic placement through spray application at varied thicknesses, enabling manufacturers to precisely target noise hot spots throughout the vehicle frame. Spray application also lends itself well to robotic application methods.

Traditionally, placing bitumen pads between door frames, under floor boards, and around other vibrating parts of a car helps dampen sound by reducing mechanical vibrations causing unwanted noise. But these pads, which need to be stocked in various shapes and sizes onsite to align with many vehicle model frame shapes, can be cumbersome to apply and increase inventory costs. They require trimming before manual application, a process that poses ergonomic safety risks and can lead to errors and misalignment during line assembly. These pads are also dense and heavy, a characteristic that undermines ongoing vehicle lightweighting efforts that automakers make to improve fuel efficiency.

In contrast, LASD offers precision alignment with manual or automated spray application and ensures complete coverage on multiple surface configurations, including difficult-to-reach areas. The ability to coat a material at varying thicknesses also reduces the material waste and excess labor costs associated with the need to cut pads to fit different car components.

**Faster redesigns**

The ease with which LASD coatings can be applied to any shape allows for faster model redesign by helping automakers meet specifications and enabling flexible application on the assembly line. Manufacturers can use automation to manage the spray application and curing processes at the same area in an assembly line, and spray application provides easy coverage around corners and tough-to-reach components that might be missed with traditional materials and techniques.

The precise robotic spray application improves facility cleanliness by reducing dust and has the potential to reduce labor costs because the one-step spray process can be completed with automated manufacturing techniques.

Typically applied in thicknesses of 2mm to 4mm, LASD coatings in a vehicle can improve sound damping by 50% to 60% compared to traditional sound damping materials. The LASD coatings can also provide equal performance at higher filler levels (up to 40% less polymer emulsion is needed in the wet formulated coating), enabling reduced cost compared to conventional materials. The high performance and material savings allow customized sound damping profiles to be formulated for different vehicles. The low density water-based

A standard polymer emulsion (left) distorts during a 150°C rapid-bake cycle, while an advanced polymer emulsion (right) remains unchanged.
acrylic polymers in LASD coatings also help with overall weight reduction of the car, contributing to fuel efficiency. Testing shows possible weight savings of as much as 60%, compared to standard materials, and up to 40% compared to a standard LASD coating.

**How it works**

Rigid materials naturally tend to resonate at audible frequencies, so cars have resonance frequencies that transmit unwanted noise. When untreated, the vibrational energy propagates into airborne noise that reaches our ear. LASD technology is a viscoelastic coating material based on waterborne acrylic polymer technology that adheres to a vibrating structure, such as the body of a vehicle, and absorbs the vibrational energy entering the system. Essentially, structural-borne vibration damping leads to sound reduction (see figure 1, page 50). Instead of the resonance frequencies creating noise, the vibrational energy is transferred into the coatings’ viscoelastic polymers and then dissipated as heat before creating unwanted noise. The absorption of mechanical stress, or energy, by the acrylic polymers reduces the resulting NVH on an ongoing basis.

To the benefit of the NVH design engineer, LASD coating formulations can be customized to meet various sound damping requirements and performance specifications. The sound damping performance of LASD coatings can be measured by the composite loss factor (CLF) — a measure of damping capability of the composite (coated substrate). The higher the CLF, the higher the noise reduction. By analyzing CLF across variables, influencing factors can be adjusted for peak performance in particular vehicle models. These variables include coating weight, coating thickness, polymer types and levels, filler types and levels, and filler-polymer interactions.

Sound damping materials are flexible and can be adjusted to perform at different temperature ranges. The temperature-dependent quality of the viscoelastic material allows energy dissipation to occur at a broad range for excellent sound-damping performance. Increased noise reduction, as indicated by a higher CLF, can occur at a range of temperatures for LASD coatings (see figure 2, above).

While LASD coatings do not require baking post-application, they are compatible with high-temperature baking systems that offer fast cure times for fast production. LASD coatings based on advanced, water-based acrylic polymer technology work well with high-temperature baking at more than 100°C. Water-based acrylic polymer-based LASD coatings allow for a better final coating as a result of advancements in polymer design. The ability to perform at varied temperatures can help meet OEM specifications for temperature while helping to maximize sound management.

**Competitive advantage**

OEMs looking to meet consumer demand for quieter vehicles and regulations for fuel efficiency will benefit from incorporating LASD coatings into their manufacturing processes. These LASD coatings are commercially available, and engineers are able to help customers develop coatings that meet specifications and achieve desired performance characteristics because of their lab, application, testing, and analysis capabilities.

After synthesizing polymers with sound damping capabilities, engineers made LASD coatings and conducted application tests in the lab and in the field. In-house acoustics testing confirmed performance characteristics, which were shown via full and detailed analytic reports.

LASD technology is already used today by many automotive OEMs to reduce overall costs and vehicle weight, while improving acoustical performance on new market models to the attuned consumer.

**Dow Coating Materials**

[www.coatings.dow.com](http://www.coatings.dow.com)

About the authors: Ray Somich is market manager for liquid applied sound dampening, and Justin Gimbal is a chemist specializing in waterborne, acrylic-based coatings at Dow Coating Materials. They can be reached at rcsomich@dow.com or jgimbal@dow.com.