

## GM goes global with materials

**General Motors** has followed a global matrix for material specifications for more than seven years, but this summer the world's largest automaker takes the next step when it moves from a region-by-region materials approval stamp to a global approval system.

"What we'll get with a global approval process is a faster way of ensuring that materials have met all the qualifications in all regions. The approval process will give us material consistency, which is highly important when doing global vehicle architectures," said Curt Horvath, Technical Fellow at GM's Global Central Engineering Center for Materials and Corrosion Engineering.

With GM assembling vehicles in 32 countries and selling automobiles in 170 countries, common specifications are a way "to reduce overall costs for engineering, manufacturing, and development," said Horvath, who addressed the topic of material challenges on a global scale at the 2007 Great Designs in Steel seminar, sponsored by the **American Iron and Steel Institute** (AISI).

The underlying issue is that the material world is not a universe of sameness. "The current global situation for materials is highlighted by wide differences in materials, coatings, and even the test methods used to [evaluate] properties. And all of this is largely based on historic regional preferences," Horvath said.

Material supply differences can cause concern, especially in the context of the industry's appetite for new steels. For instance, in 2004 low-carbon types accounted for approximately 41% of a typical vehicle's body structure, but in 2012 that will drop to about 12%. The industry's typical 2012 vehicle will be dominated by conventional high-strength steel (44%), advanced high-strength steel (AHSS) (36%), and ultra high-strength steel (8%).

"Unfortunately, for global manufacturers like GM, advanced high-strength steels (AHSS) have limited availability in some regions. Also, on a region-to-region basis, these grades tend to be variable in their properties and potentially even perfor-



■ Ultra high-strength steel    ■ Dual-phase steel    ■ High-strength steel  
■ Bake-hardenable steel    ■ Quiet steel    ■ Sheet metal

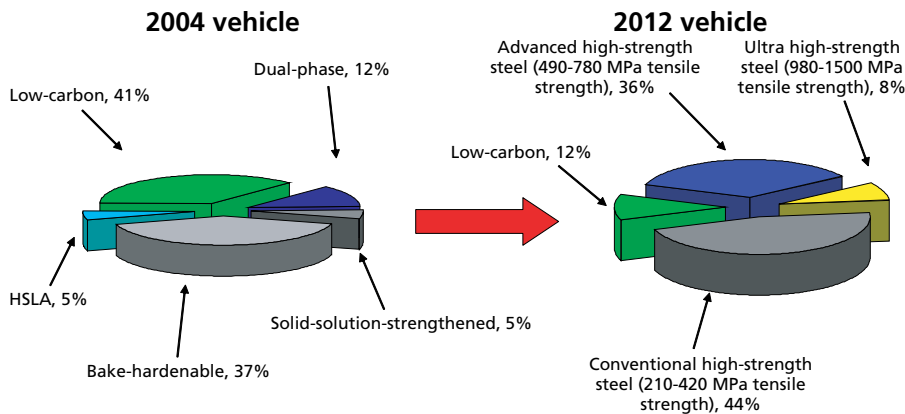
The different steels used in the body-in-white of the new Saturn Outlook are shown.

mance, largely due to supplier capabilities and regional preferences," said Horvath.

Dual-phase steels—classified as AHSS—are in demand, but "just because you're specifying cold-rolled DP 800, you can get different weld performances depending upon the chemistry of the steel. We don't want to run into manufacturing issues or availability issues," said Horvath.

The steel industry acknowledges the situation. "What he says is absolutely accurate," said Ronald Krupitzer, Vice President of Automotive Applications for AISI, adding, "It will be important to recognize the growth of new AHSS, so that global specifications—starting at the lower strength levels first—are feasible."

Current sourcing dilemmas associated with AHSS are "just a natural part of the development process for new steel grades. Global sourcing of developing steel grades is on a slower track," said Krupitzer, who spoke with *AEI* while he was on a recent business trip to China. That automaker is shipping parts from North America to China "because dual-phase 590 is not presently available for a front rail application," he said. That sourcing situation, according to Krupitzer, will change just as it changed for high-



Note: Body structures only

A pie chart, provided by GM's Curt Horvath, shows the change in steel usage for a typical car in 2004 and 2012.

strength low-alloy (HSLA). "Those steels are available anywhere that they're required," he said.

Decision-making at GM is influenced by steel grades. For example, the 2007 **Saturn Outlook**, **GMC Acadia**, and **Buick Enclave** crossover vehicles were engineered with steel-grade preferences being the guide to part design. "If you design the part first, you're oftentimes constrained by formability of the part. Whereas, if you choose the grade of steel first, the part design can be configured for formability," said engineer Terry Swartzell, a system architect for GM.

GM's new full-size crossover vehicles' steel usage by mass is as follows: 34% for HSLA, 26% for bake-hardenable steel,

26% for low-carbon, and 7% each for dual-phase and martensite. In the full-size crossover vehicle example, a 7% usage translates to a mass of about 25 kg (55 lb). Not on the list of steel grades for the three crossovers were boron steels for the body-in-white. "Boron steel did not achieve acceptable cost-benefit results for cost-effective mass reduction on this program," said Swartzell.

An undesirable cost equation can stymie usage for a given material, but the lack of worldwide availability for a material can halt its usage. As an example, **Opel** in Europe is presently using B0 (a bake-hardenable without pre-strain) for exterior panels such as hoods and doors. But the material is not available in other

markets. "So obviously, that's one grade that's going to go away for GM. It has a limited life," said Horvath.

Coatings are another area with varying degrees of availability around the globe. North America and China providers of coatings typically can handle hot-dip galvanized zinc, hot-dip galvanized zinc-iron, and electro-galvanized zinc. In contrast, Europe typically lacks hot-dip galvanized zinc-iron availability, while South America typically lacks availability of electro-galvanized zinc.

In Japan, Korea, and Australia, hot-dip galvanized zinc-iron is the norm. "As a global manufacturer, you want to have one coating because without that you get different corrosion performance from region to region, which means you have to redo manufacturing processes," said Horvath.

With GM launching a global materials approval process, the associated benefits can be meaningful because of "increased engineering and manufacturing efficiencies, resource leveraging, reduced engineering and validation costs, and speed to market. Those are just a few of the advantages that can be realized by both the automotive and steel industries through globalization and commonization," Horvath said.

Kami Buchholz

## Trucks get boost from copper motor rotors

Four 140-hp (104-kW) electric motors help power the latest generation of **U.S. Army** severe-duty trucks. The ac induc-

tion motors use die-cast copper rotors on each of four axles. The new rotors are considered a breakthrough in motor tech-

nology developed by the **Copper Development Association** (CDA) and delivered under the Copper-Based Casting Technology (C-BCT) program.

For large automotive vehicles, this is the first such application of a copper rotor, according to Ken Geremia, Communications Manager for the CDA. But the technology has already appeared in some passenger cars, including in the electric motor of the **Tesla Roadster**, which was announced last summer. Geremia noted that **Siemens** introduced several lines of integral motors in the U.S. last spring, and that other companies have sold them in Europe for the past couple of years.

In the Army trucks, the 520-V motors are powered by a 400-hp (298-kW) diesel engine, resulting in a hybrid drive system



Oshkosh's third-generation Heavy Expanded Mobility Tactical Truck features a diesel-electric drive system that makes use of copper rotors for the ac induction motors.

that can move the 35,000-lb (15,875-kg) vehicles and run a 335-kW generator to operate field hospitals, command centers, or airstrips.

Called ProPulse by **Oshkosh Truck**, the hybrid-electric drive system is said to decrease emissions and increase fuel economy by as much as 40%. Aside from several configurations for the military's 8x8 HEMTT-A3 (Heavy Expanded Mobility Tactical Truck) series, the drive system is also configured for commercial use with refuse vehicles. Oshkosh says the new drives will lower life-cycle costs as well as lower interior and exterior noise profiles.

The electric motors were manufactured by **Reliance Electric**. Reliance's Director of Advanced Technology, Rich Schiferl, said in a statement that "using the die-cast copper rotor technology was the only way we could meet the rigorous military requirements for weight, size, and performance." According to Schiferl, the CDA-developed process for die-casting the rotor now enables cost-effective production of such rotors on a large scale

for motors in this type of application.

It is known that a copper rotor is more efficient than a traditional aluminum rotor, said Schiferl, because copper is a better conductor of electricity and has lower resistance. Because of that, motors with copper rotors can be smaller and run cooler. "The result is an induction motor with the highest power density possible today," he said.

Copper's "primary physical attribute is superior electrical conductivity, which enables greater efficiency," Geremia agreed. When asked about the cost of a copper rotor vs. an aluminum rotor, Geremia said that manufacturers and buyers find them cost-effective, but he could not provide specific numbers.

The C-BCT research program is sponsored by the **Army Research Laboratory** and is tasked to develop, demonstrate, and deploy applications of copper-based alloys to make significantly lighter, more efficient ac induction motors for use in defense and industrial systems.

The CDA helped organize a technical



Siemens introduced several lines of integral motors in the U.S. last spring. Shown is a cross section of a copper rotor in an electric motor.

session titled Copper Alloys at last month's **SAE World Congress** in Detroit. The session explored the use of copper alloys in electric motor technology, electrical and electronic connectors, HVAC systems, and other potential automotive applications.

Ryan Gehm



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