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GM: 30,000-mile Drain Intervals Are Achievable

By Nancy DeMarco

Typical drain intervals with General Motors' Oil Life System, the onboard computer algorithm that tells drivers when it's time to change their motor oil, are 8,500 miles, versus 5,000 for GM's competitors, a GM executive told last week's World Tribology Congress. Drain intervals over 30,000 miles are achievable with minor engine modifications and appropriate oil quality.

"We cannot say exactly when it will happen, but drain intervals will be lengthened," James A. Spearot, director of GM's Chemical & Environmental Sciences Laboratory in Warren, Mich., told the World Tribology Congress meeting in Washington, D.C. Sept. 15. And it will happen, along with numerous other technological advances, thanks to the contributions of tribology – the science of rubbing surfaces.

"Tribology is on the cusp of a renaissance," Spearot said, "triggered by the increasingly competitive manufacturing environment around the world." Manufacturing enterprises must have efficient production, and they must produce products that customers want and need. Tribology affects both.

Using the auto industry as a case study, Spearot introduced some of the tribological challenges the GM Research and Development Center is tackling.

"The auto industry doesn't sell cars and trucks," said Spearot, "what we really sell is 'automobility,' the freedom to move around at will." Vehicle sales, which offer accessibility and personal freedom, relate directly to personal income, he continued.

In 2000, 12 percent of the world's population had personal transportation, and Spearot projected this will reach 15 to 16 percent by 2020. "But," he cautioned, "there will be societal impacts."

These challenges include energy (where will it come from?), environmental degradation, safety, congestion ("a very difficult challenge," said Spearot), and affordability. In almost every case, potential solutions rely in part on tribology. Advanced propulsion systems and advanced materials will address energy and environmental concerns. Vehicle electronic controls and software will mean more safety. Agile manufacturing techniques will contribute to affordability. Telematics might tell drivers how to avoid congestion.

Quick plastic forming (QPF) of aluminum is the first example Spearot cited in the area of using tribology to improve manufacturing productivity and environmental compliance. Automakers want to take the weight out of vehicles, Spearot noted, and this GM process allows the company to form complex parts from lightweight aluminum and magnesium alloys. "Check out the Chevrolet Malibu Maxx Lift Gate," he said. "It's made by this process."

Tribology is essential to the entire medium-temperature (500 degree C) QPF process. The surface quality of the die is critical, and microscopic galling is an issue. In addition, "we're still looking for a good laboratory wear test to make friction measurements for the process," said Spearot. "Current tests do not accurately measure deformation."

Lubrication is also critical to the QPF process, reducing the coefficient of friction, improving formability, increasing die life and reducing forming cycle time, among other functions, but irregular lube application can deform the finished piece, Spearot said. GM has looked at boron nitride lubricants, which are "good but expensive," and at graphite, which is "good and cheaper, but has cleanability issues." And both lubricants have to be removed after the process.

Turning to tribology in product performance and durability, Spearot noted that GM now uses lightweight aluminum engine blocks with cast-iron liners. The challenge is to replace the cast-iron liners, he said. His researchers are looking at new alloys, such as high-

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silicon-content aluminum alloys, and they have tried spraying an iron coating into the engine cylinders, but the process isn't resolved yet. "We still need to better understand the wear surfaces."

Extending oil drain intervals is another area of product performance and durability, driven by customer demand, environmental benefits, and increased warranty protection. GM is concerned, Spearot noted, about the "uncertainty of service-fill oils."

Major drain interval improvements are achievable with appropriate oil quality and hardware technology, to over 30,000 miles with minor engine modifications and over 40,000 miles with major engine modifications, he added. "But we still need to strive for the best fuel economy, no compromise on engine durability, and no negative impact on emissions systems."

GM's goal in every application is to increase lubricant life. The new Dexron-VI trademarked automatic transmission fluids for all applications worldwide will be fill-for-life, Spearot said, adding that "'life' will be defined as perhaps 100,000 or 150,000 miles."

Looking ahead, said Spearot, GM is studying advanced materials and tribological systems. One key goal is to develop "self-healing" tribological surfaces based on shape-memory materials such as nickel-titanium alloys, for recovery of scratches.

In every application, Spearot concluded, "the correlation between bench tests and performance is a critical requirement. [The automotive industry] needs a fundamental understanding of mechanisms and predictive models to guide materials development." Tribology is indeed the critical enabler for improved efficiency, productivity and performance.

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