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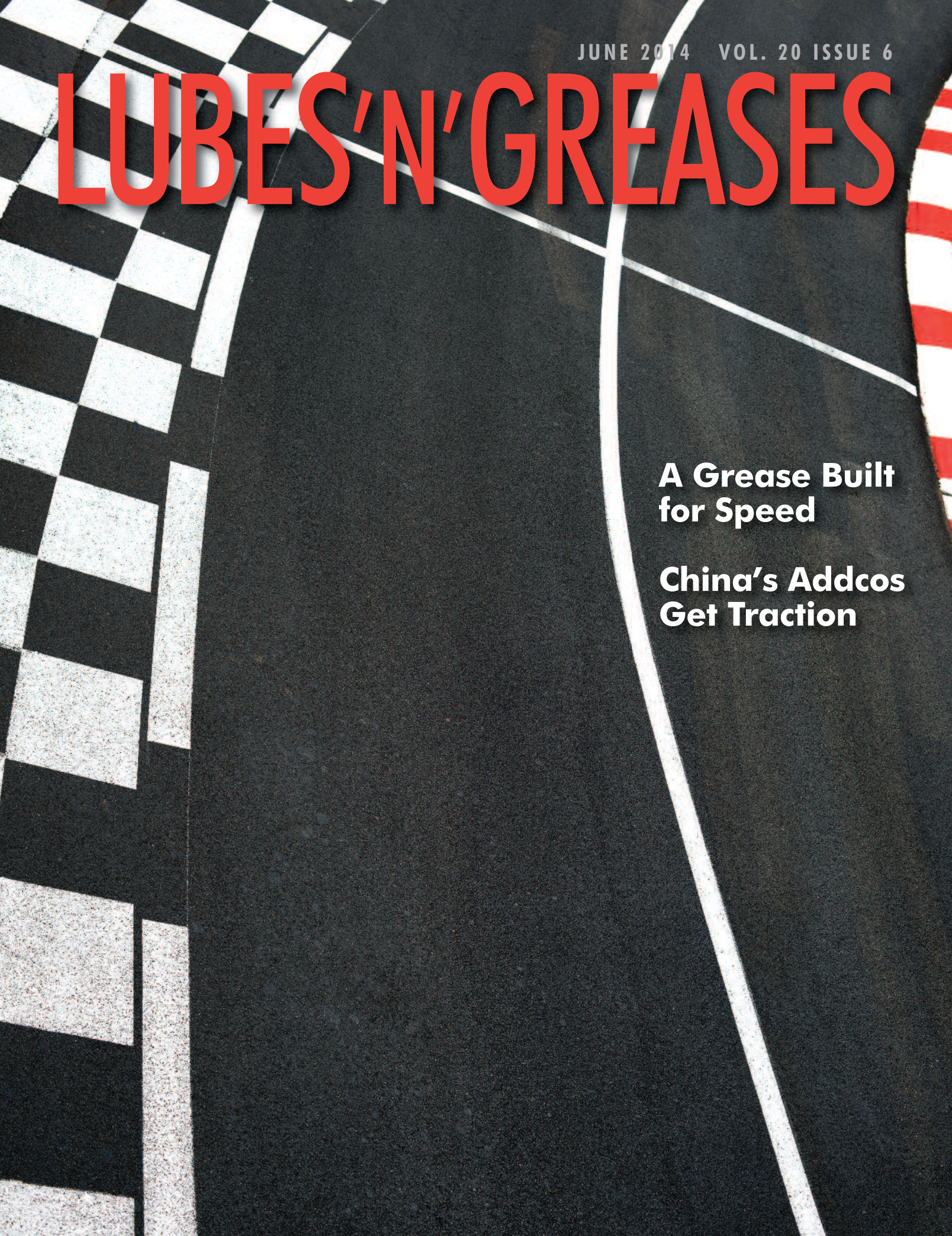
# LUBES'N'GREASES



## A Grease Built for Speed

## China's Addcos Get Traction


*Jeff Brown AUT Icon Sports Photos-Newscom*


# On a Fast Track to Industry

By Brian Kusak and Aaron Marney

*Seeking higher-performing greases for demanding applications like heavy equipment and rolling mills, Quaker Chemical joined the pit crew of an Indy 500 race team.*

Some people may believe that using a $1 million racecar as a test "lab" to develop a better grease is a bit of a crazy idea. Nonetheless, Joel Garrett, president of Quaker Chemical Corp.'s subsidiary Summit Lubricants Inc., thought it was a great idea. After working in conjunction with Sarah Fisher Hartman Racing, it turned out he was right.

Here's why: Racecars operate under extreme conditions that vary widely from track to track, creating a perfect real-world test situation. Further, race engineers exactingly monitor every detail of stress placed on the vehicle — including time, speed, load and temperatures. They even measure the temperature on the inside of the bearing case. Precise measurements and proper material choices are imperative because,

*Quaker Chemical's logo points the way on SFHR's No. 67 Indy car, as its grease reduces rolling friction in the wheel bearings.*


KIRK DEBRUNNER/REUTERS/Newscom

*Sarah Fisher Hartman Racing driver Josef Newgarden has adjustments made to his car at a stop in the pits during last year's Indianapolis 500.*

in the sport of auto racing, the deterioration of a single metric can be the difference between winning and losing a race. In trying to make their team's racecar the fastest on the track, one material these race engineers analyze is grease.

In 2010, Quaker Chemical formed a partnership with Sarah Fisher Hartman Racing to see if together they could develop new greases that would reduce mechanical loss of energy and to extend the life of the bearings. The SFHR team was hoping for a subtle but crucial fraction-of-a-second advantage — enough, in a close race, to mean the difference between a first and third place finish.

SFHR was established in 2008 and is owned by former driver Sarah Fisher, the youngest woman ever to compete in the Indianapolis 500, and businessman Wink Hartman. Fisher also was the first woman to run a full IndyCar Series schedule, and her racing organization has competed in the IndyCar Series since 2008, earning its first victory in 2011 at Kentucky Speedway.

For its part, Quaker Chemical was hoping to leverage the SFHR team's data and advance their understanding of grease under extreme stress conditions, to gain market advantage in a wide range of industries. Headquartered in Conshohocken, Pa., Quaker is a global provider of process fluids, chemical specialties and technical expertise to a wide range of industries, including steel, aluminum, automotive, mining, aerospace, tube and pipe, cans, and others.

### *A Systematic Approach*

Typically, for wheel bearing greases, a team's engineers choose from a selection of existing products. The team's engineers routinely keep log books demonstrating how different greases performed on any given day. With many variables to weigh — such as the type of track, the temperature and the weather conditions — the selection process can be more trial-and-error than science. Therefore, the SFHR team and Quaker decided there had to be a more systematic, scientific approach to finding a better, more reliable lubricant for wheel bearings.

To develop performance requirements for the grease, Quaker's chemists leveraged the data from the SFHR logs, which included data on every course and event, based on the

team's standard, off-the-shelf product. Engineers logged the car's housing temperatures, brake temperatures, speeds, the levels of down force at the end of a straightaway, and more. From this they formulated criteria for the "ideal" grease.

What the SFHR racers wanted was a grease that would provide the same temperature capabilities as the standard products, but with a lower drag. To their minds, a grease with a lower drag would be one of several tiny but crucial tweaks that Aaron Marney, one of their team engineers, could help them achieve.

Back in the research and development lab, Quaker scientists ran the team's standard grease through a battery of tests to establish a benchmark. Next, they created several grease prototypes uniquely suited to the team's requirements for temperature, speed and load.

To test the prototypes, Quaker designed and built a test rig to simulate the forces of a an IndyCar race. This step was vital to the development process, as actual track time is so critical to the race and so limited. Then, the grease was tested in a real racecar on a real track and eventually, the Quaker grease was packed into the wheel bearing case on race day. To date, SFHR has run with two versions of the new grease (both made with synthetic base oil and lithium complex thickener) at races in Indianapolis, Milwaukee and Pennsylvania's Pocono Raceway. "It holds up well and gives us an advantage over the lubricants that we typically use," says Marney about the Quaker greases.

### *Anatomy of a Racing Grease*

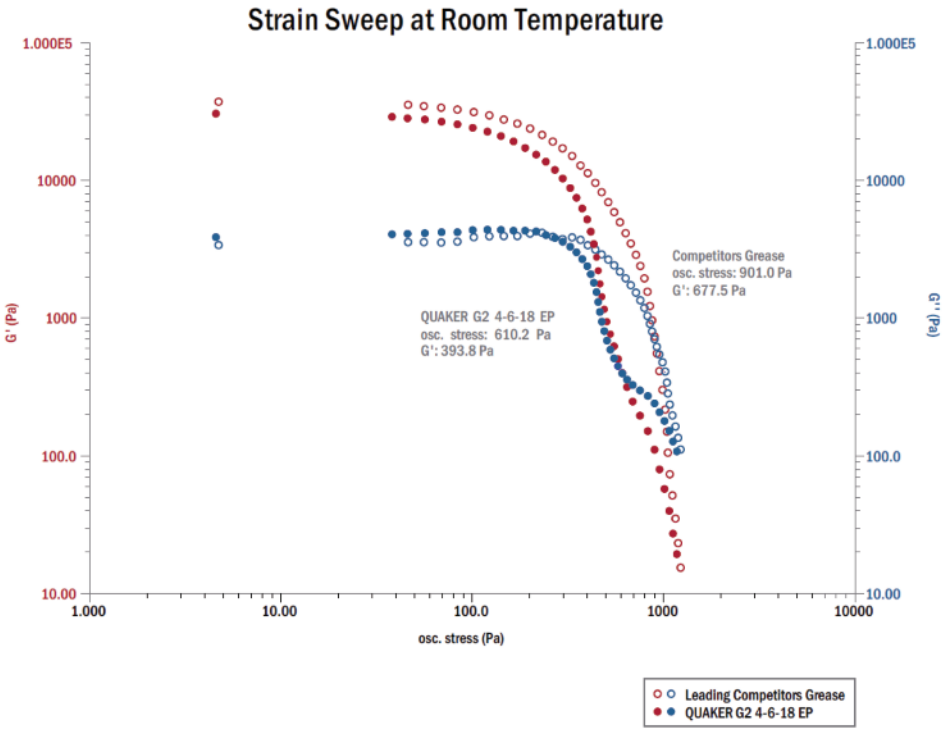
A race team needs to have a range of greases on hand because different types of courses and conditions require different properties. For each race, engineers have to look at different scenarios.

- **Viscosity/Temperature**. Grease needs to be thick enough to lubricate even at high temperatures, but not so thick so as to soak up energy and slow the car down on a long straightaway. Temperatures on an lengthy oval course can be from about 140 to 176 degrees Fahrenheit (60 to 80 degrees Celsius). That's hot, but nothing a thin grease can't handle. But on a road course or a short oval course, where the car will be braking frequently to navigate corners and sharp turns, the temperature of the housing that encases the wheel bearings can climb above 212 degrees F (100 C). These courses require thicker, more viscous greases that can withstand very high temperatures.
- **Load**. During a race there is significant pressure on the wheel bearings. The grease needs to be able to withstand the weight of the car pushing down, and the force that is applied when the car navigates turns. In addition, on a long straightaway, there is a significant amount of down-force.

The SFHR engineers found that the new greases provided a 10 percent gain on power consumption over the standard grease that they used. Further, the new greases allowed Marney and his team to use 55 percent less grease than the usual, prescribed volume of grease. With the Quaker-formulated product, Marney explained, "we're running with less than half of what we would feel comfortable running with other materials."

Moreover, when drivers tested the set-up on the racetrack, the reduction in the amount of grease provided them with an extra 4 percent gain on power consumption. "That [advantage] is huge," says Marney.

Ultimately, reducing mechanical losses with Quaker's custom greases resulted in improved race times of up to 0.5 second per lap, over the standard grease. That's impressive, especially when you consider that the pace at Indianapolis Motor Speedway can be as hot as 40 seconds per lap. "It's a gain that we see in the race data," observes Marney.



### *The Science Beneath*

Taking a closer look at the science behind these results, the graph seen earlier shows the results of a strain sweep test, a rheological test of a material's liquid- and solid-like behavior. This test is especially applicable to a complex system like lubricating grease.

In the graphic, the red axis and curve show the solid-like behavior, or "elastic modulus," and the blue axis and curve show the liquid-like behavior (viscous modulus). The point at which the two curves intersect shows where the product has equal liquid- and solid-like properties.

The rheological test data demonstrate that the Quaker grease, on the red axis, requires less force (Pa) to strain the material when compared to a rival grease. In addition, Quaker's grease has a lower stress value on the x axis where the two curves (red and blue) cross over, demonstrating that it requires less force to have equal liquid- and solid-like characteristics in the grease.

These values translate into less energy required to move the bearing, and reduced friction when the bearing is in motion.

SFHR has gained an edge using grease developed by Quaker on their wheel bearings. Now they are ready to tackle other mechanical facets. "Now we are talking about using lubricants and greases on other mechanical parts," says Marney.

### *Benefits for Industry*

"The technical development we did with the SFHR team was a rare opportunity," comments Joel Garrett of Summit Lubricants. "The real-time data we were able to collect will help us continue to evolve our high-performance greases."

The knowledge gained from this project is directly transferable into the industries Quaker serves, he adds. "Bearings are used everywhere — heavy equipment, food machinery, steel mills, etc. However, it's very difficult to collect such precise data on grease performance," says Garrett.

"What is next? Having completed the development of a wheel bearing grease, SFHR and Quaker are ready to tackle lubricants for other mechanical systems in the SFHR racecars. Quaker will also apply this additional knowledge to a new generation of specialty greases that will help industrial customers further extend the life of their tools and equipment." ▮

*Brian Kusak is technical director at Summit Lubricants, a subsidiary of Quaker Chemical Corp., and Aaron Marney is team engineer for Sarah Fisher Hartman Racing. For nearly 100 years, Quaker has served industrial customers worldwide with innovative lubrication technologies and expert services. With its Summit Lubricants business, it supplies specialty greases that include unique and proprietary formulations. For information, visit www.quakerchem.com and www.summitlubricants.com.*