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Hard-working oils

The importance of high-performance universal tractor transmission oils is greater than ever for the farm tractors of today and tomorrow

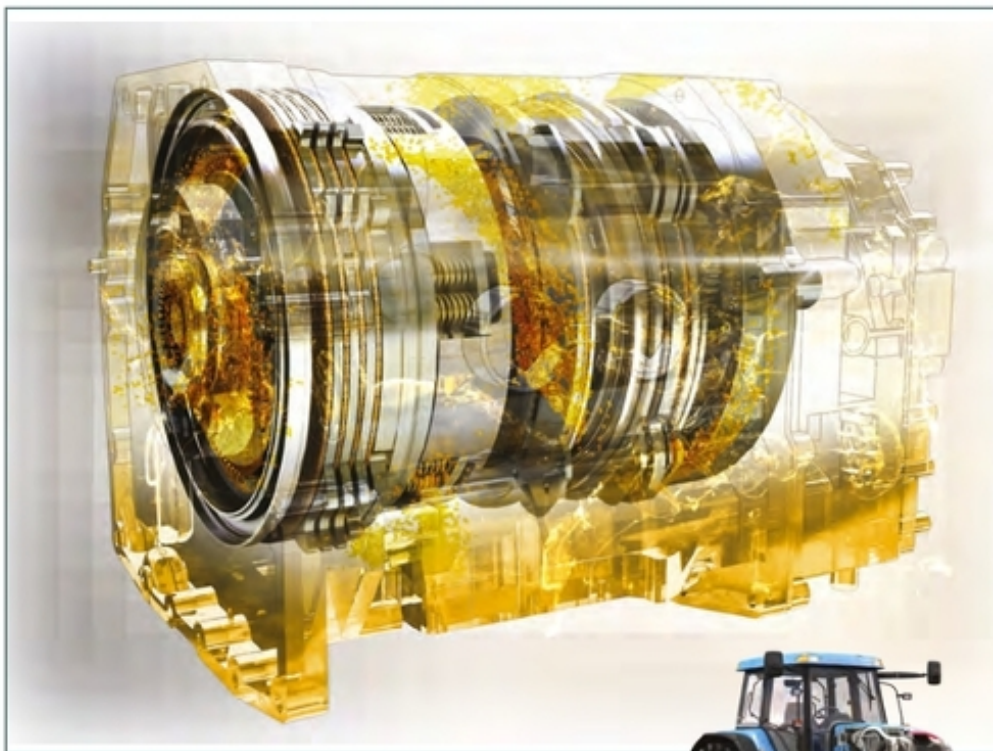
▶ Farm tractor universal tractor transmission oils (UTTO), as their name suggests, are designed to lubricate more than just the transmission in farming equipment. In fact, a UTTO is normally also required to lubricate the tractor axle, including the differential, wet brakes and final drives, as well as serving as a high-performance water-tolerant hydraulic fluid.

The initial design, specification and testing of the additive chemistry inside a UTTO is highly complicated. The highest-performing driveline systems are able to combine fluid and hardware design early in the development process. UTTO design is critical because of the specific requirements each area of the tractor's driveline brings. Poor quality lubricants can be prone to oxidation and make the tractor vulnerable to wear, brake chatter, corrosion and the effects of cold temperatures. However, high quality lubricants with advanced additive packages are available that work to prevent these ailments, protecting equipment, improving performance and extending tractor life.

Hardware evolution trends

The global demand for agricultural output continues to grow due to growth in population, income per capita and consumption. This demand drives the requirement for greater intensity and productivity in agriculture, and when combined with high government subsidies it creates strong economic drivers for increasing mechanization and equipment evolution.

Engine emissions legislation, such as Final Tier 4/Stage IV, requires increased exhaust cleanliness and higher levels of efficiency than ever before.



With hard-working transmissions such as those found in tractors, a high-performing oil is a crucial factor in protecting components and boosting the life of the unit.

Farm tractor driveline hardware is adapting to keep pace with all of these demands, which include a general increase in output with greater power densities and operating temperatures within the driveline. Transmission designs are evolving to enable greater efficiency through increased gearing, so the engine can operate at its most efficient output speed. Powershift transmissions are still dominant although CVTs are now also widely used in tractors. They are often used in higher-powered

units or the more premium end of tractor ranges and work very differently from their on-highway chain-and-belt counterparts. These transmissions use piston pumps with modified slippers to drive banks of planetary gear sets. As with other areas of the driveline they require more advanced high-performance UTTO technology.

Another trend is the requirement for enhanced clutch performance in transmissions and wet brakes, and the increasing use of new or a broader range of friction materials. These include the more traditional sinter materials as well as modern carbon-based composites. However, both are only effective



when combined with an appropriate UTTO that has the right friction modifier chemistry. The increasing diversity of materials that are used in tractors across the industry including tier suppliers means lubricant chemistry needs to be more universal than ever before.

Common causes of failure

The need for an industry upgrade in hardware and fluid technology is demonstrated in the results of a

recent UK market survey that was commissioned by an independent third party on behalf of Lubrizol. This study looked at common causes of hardware failure that occurred in farm tractors and found that 23% of farmers and 32% of maintenance service providers experienced failures in the wet braking system, while 36% of farmers and 50% of maintenance service providers experienced failures in tractor transmissions. Reasons for failures in the wet brakes included friction-disc wear and system overload, while in the transmission friction-disc wear along with factors such as broken gear teeth, wear and oil pump failure were noted.

UTTO protection

High-performance UTTO containing the right additive packages will be able to effectively protect clutches, gears and pumps by providing balanced friction, resistance against oxidation, anti-wear protection, water tolerance and an enhanced performance in extreme temperature and harsh conditions.

The lack of appropriate friction performance causes a screeching noise or 'chatter' in wet brakes – lower-quality fluids do not interact with friction materials as effectively as UTTOs that have chemical additive packages that are specially designed to ensure optimal friction performance. High-performance fluids improve braking capacity and prevent noise for greater operator safety and comfort.

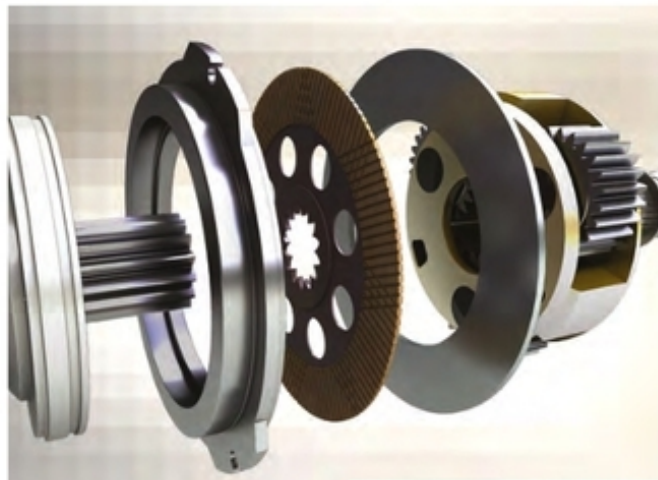
High-performance fluids also have to provide protection against excessive wear on gears, bearings and the soft, yellow metals in hydraulic pumps. Without the right additive package, a lubricant's load carrying, anti-wear and extreme pressure characteristics fail and result in severe ridging, visible wear and scoring on gear parts.

In CVTs, the UTTO's viscosity after shear is also particularly important to system efficiency since any fluid that thins markedly can pass through the pump slipper plate and piston seal, creating a loss in hydraulic efficiency and increased temperatures. Fluids which shear to lower than their intended viscosity also have the effect of increasing wear in the pump components.

Specifications for CVTs often require a higher shear stability to be demonstrated in tests such as the CEC procedure L-45-99.

A lubricant's viscosity index (VI) is a function of how it changes with temperature. High-performance viscosity modifiers included in the UTTO formulations enable the VI to be adjusted to reduce the impact that temperature has on viscosity. This maintains the efficiency of the drivetrain film thickness, reducing wear in the transmission and axle.

One way for the farm tractor end-user or maintenance service provider to confirm that the UTTO has good shear stability for the CVT is to check that the product claims match those required by the maintenance schedule.



High-performance fluids improve the performance of wet brakes and cut down on chatter, as well as prolonging the life of the friction materials

Oxidation causes formation of sludge deposits and thickening of fluids, which reduces performance and shortens the life of any tractor. Oxidation protection provided by the additives included in high-performance tractor hydraulic fluids also keeps parts cleaner. Eliminating sludge makes for better overall performance, gear protection and reduced brake noise. Not only that – clean fluids don't have to be replaced as often.

Water is harmful to a tractor's seals, valves and yellow metal components in pumps. High-quality tractor fluids can reduce the harmful effects of water contamination that otherwise lead to corrosion and erosion, which often leads to reduced tractor performance and potentially hydraulic pump failure.

Water can mix with lower quality UTTO fluids to form corrosive mixtures which erode the yellow metal on hydraulic pumps, causing deep scratches on the pump's brass piston shoes. High-performing tractor fluids have additives that effectively emulsify water contamination, enabling the fluid to protect parts from corrosion and erosion in the presence of water. This optimizes tractor performance and reliability.

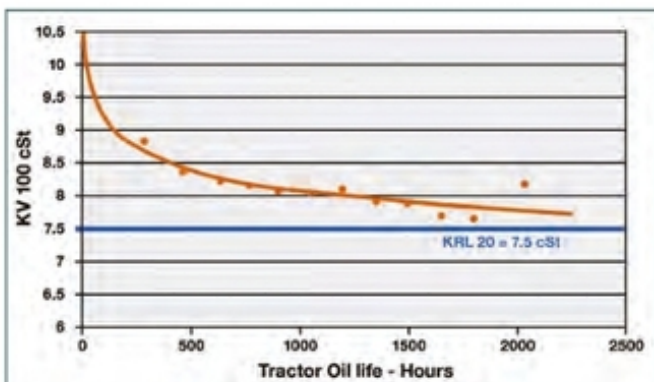
High-performance fluids are crucial to cold temperature operation as well. Without good additives and viscosity modifiers, some fluids take longer to provide

an adequate lubricant film to protect against metal-to-metal wear. Losses in equipment productivity can also result from the need to excessively idle the engines to allow the UTTO to warm up to a suitable operating temperature. Superior fluids are formulated to be able to perform in temperatures below freezing and ensure instant lubrication of moving parts for the tractor's transmission, steering, braking and hydraulic pump functions.

Farm tractor OEMs and tier suppliers are increasingly looking for UTTOs that will enable new hardware designs that can reduce operating temperatures, provide greater fuel economy, improve clutch durability and reduce chatter with new friction materials while also being compatible with older materials in existing equipment, and improving wear protection and durability of gears, bearings and pumps.

Now it is more important than ever for designers of farm tractor drivelines to recognize the UTTO as a dynamic component and to make considerations early in the development process. ☺

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It is important for the viscosity modifier to provide sufficient shear stability to keep the UTTO above the kinematic viscosity (KV) limits, such as those noted in blue, when the tractor's continuously variable transmission is in operation in the field.