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Wind Turbines Power Up with Oil

Specialty lubricants breathe extra life into wind power stations

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Londonderry, NH – (August 18, 2006) – As energy experts explore ways to reduce U.S. dependence on oil imports and supplement traditional fossil-fuel energy, wind is emerging as an attractive alternative energy source. In fact, according to the American Wind Energy Association (AWEA), the U.S. wind energy industry is on track to bring on line more than 3,000 megawatts (MW) of wind energy this year, contributing to the estimated 25 billion kilowatt-hours (kWh) of electricity that will be generated by wind farms across the country in 2006.

The performance of today's wind power stations varies. Output ranges from several MW up to 10 MW for prototypes already under development. As output increases, so does the importance of the role lubricants play in the operation of wind power stations. Lubricants ensure the efficient operation of these facilities and are an integral part of the system. As a result, lubricants must be accounted for in the design of wind power stations.

Wind power stations require a wide range of lubricants. The main task of the lubricant is to ensure reliable operation of the machine elements. The lubricant should also meet demands for service life, load carrying capacity and thermal resistance over an extended period of time. Important lubrication points in wind turbines include the main gear drive, yaw system gear, main and generator bearing, pitch adjustment unit and nacelle slewing ring.

Wind power stations make specific demands on lubricants

Plant operators require that the lubricants applied to these machine elements deliver prolonged service life and extended re-lubrication intervals. Although the engine oil of a car is changed after 3,000 to 5,000 miles, which corresponds to an oil service life of 300 to 600 hours at an average speed of 31 mph (50 km/h), the gear oil in a wind turbine is not changed until the unit logs as many as 25,000 to 50,000 service hours.

According to Tim Brownlie, sales support, wind energy, Klüber Lubrication ,"Changing the oil in a wind turbine is not an easy task. The service technician must get to the top of a two- to three-hundred-foot tower, while the product is raised to the top of the tower in a pail. Prior to this, the turbine must be shut down, stopping production until the oil change is complete. It's easy to see the advantages that longer service intervals offer the operator. In addition to reduced risk factors associated with the procedure, longer intervals also mean less downtime, increased production and savings on the cost of lubricants."

Most commodity lubricants cannot meet these demands for extended service life. "Commodity products are more generalized, designed for a variety of applications," Brownlie continued. "As a result of their one-size-fits-all approach, the lubricants tend to lose some of their performance characteristics – characteristics that may be critical to more specific applications.

Brownlie continued, “In the case of wind turbines, for example, lubricants must satisfy a number of performance requirements that are unique to the industry. The turbines are located all over the world, on mountain tops, along coastlines, in deserts, etc. So, in addition to the longevity issues already mentioned, lubricants must be able to withstand a variety of environmental conditions, including temperature extremes and moisture, in addition to being able to resist corrosion and oxidation. Dirt in the environment is also an issue, because cleanliness of the oil is critical to its performance.”

Turbine design creates additional demands on lubricants

Changes to the design of wind turbines create additional demands on lubricants that are used in the wind power industry. As interest in the industry grows, engineers are working to improve the efficiency and the output of wind turbines. Gearbox designs contain more equipment designed to produce more work, and more work means the generation of more heat in the gearbox. As a result, lubricants must function at higher operating loads while helping to reduce temperatures in the gearbox.

Mineral oils cannot meet these demands, and operators of wind power plants are turning to synthetic oils for the range of benefits they offer, including improved thermal resistance, better viscosity characteristics, product longevity and longer machine component life. Different base oils (polyalphaolefin, polyglycol or rapidly biodegradable ester) are used to formulate these gear oils. Today, however, many of these traditional synthetic oils cannot meet the new requirements created by changes in the wind power industry. As a result, operators are turning with increasing frequency to new, higher performance synthetic oils.

“The wind power industry is setting the bar for the lubricant industry,” Brownlie said. “They want to go higher. They want to go faster. They want to go in remote corners of the world. They want to change out their oils less frequently. The list goes on, and as it does, so does their willingness to pay for the ability to do these things.”

The lubricant industry is responding with specialty products that meet and even exceed the standards set before them. “We’re looking at new lubricants that offer high thermal resistance and resistance to oxidation; lower change in viscosity at rising or falling temperature; lower friction coefficients; high wear protection for bearings and gears; good load-carrying capacity in bearings and gears, and low residue formation,” Brownlie continued. “They also offer extended service life and economical operation. Developing these lubricants requires knowledge of additives – their chemistry, which additives to use, what combinations to use them in – and of base oils. The more pure the molecular structure of the base oil, the better the lubricant.”

New synthetic oils face tests and standards

Like the traditional synthetic oils that preceded them, these new, high-performance synthetic oils are subject to the tests of original equipment manufacturers (OEMs) and must meet a number of universal standards. For example, industrial gear oils are classified in accordance with DIN 51 517. Part 3 of this standard defines the requirements for gear oils that are exposed to high loads. In addition to the usual tests on viscosity, pour point, foaming characteristics, steel and copper corrosion, the scuffing load characteristics of the oils are determined in the FZG (Gear Research Center) scuffing load test. DIN 51 517, Part 3, stipulates a scuffing load stage greater than 12 for gear oils.

Because gear oils should also be suitable for lubricating the rolling bearings in the gearbox, the revised standard DIN 51 517, Part 3, also contains the FE 8 rolling bearing test rig developed by the rolling bearing manufacturer FAG. The FAG FE 8 test rig can be used to assess the anti-wear properties of an oil and its effect on the rolling bearing service life. In this test, the wear of the rolling elements should not exceed 30 mg.

The assessment of gear oil performance for wind turbines also includes tests that measure scuffing load resistance and micro-pitting resistance. A test developed by FZG, measures anti-wear properties of the lubricant at low gear speeds, as the planetary gear stage is run at the lowest speed. In this test, better performing lubricants fall within the low wear category.

Gear efficiency is determined to a large extent by the friction characteristics of the lubricating oil. The friction coefficients of different base oils can be seen in the result of the FZG test rig. Today's new gear oils can reduce temperatures by as much as 68 degrees Fahrenheit (20 degrees Celsius) and power losses by as much as 18 percent when compared to standard gear oils. "By lowering the friction component in a wind station, you improve efficiency, increase power output and generate additional income," Brownlie explained.

Power stations embrace specialty lubricants

Wind power stations around the world are taking advantage of the benefits that new high-performance lubricants offer. In addition, companies like Midland, Texas-based Global Wind Power Services, which provides service to the wind power industry, are recommending these new lubricants to their customers. Global uses as many as ten different Klüber Lubrication products in the wind turbines it services. "Their synthetic oils work well for us, reducing heat in gear boxes and prolonging the use of the oils," said Junior Yanez, Global vice president. "These oils keep gears running smoothly and extend the interval between oil changes." The newest additions to the Klüber line include Klübersynth GEM 4 N – polyalphaolefin, Klübersynth GH 6 – polyglycol and Klübersynth GEM 2 – rapidly biodegradable ester. Each of the products complies with or exceeds performance parameters stipulated in the standards currently in place.

"Operators of wind power stations recognize the value of the new high-performance lubricants," said Brownlie. "The longer lubrication cycle they offer means less downtime and fewer costs associated with maintenance. Efficiency increases, saving money and earning money, and, thanks to good wear protection, improved micro-pitting resistance and the performance of the gear oils, the lifecycle of the turbine itself increases, saving the operator additional money."

As a result, the value placed upon high-performance lubricants continues to increase. What was once a commodity selected on the basis of price is now considered by many as a machine element, carefully specified in much the same way gears and other components are specified. And, like quality components, specialty lubricants promise performance, deliver savings and ensure the reliability of wind power stations around the world.