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Where a gearbox oil sample is taken is just as important as how it is taken. As this second installment of a two-part series explains, it's all about obtaining the most evidence from the best possible location.

IN OUR PREVIOUS INSTALLMENT WE explained how wind technicians can use their physical senses to diagnose some common wind turbine gearbox problems while up tower. The color and smell of the oil, for example, can relate to such abnormal operating conditions as oil degradation, water emulsification, and solids entrapment. These properties can quickly tell a technician that an issue may be lurking and promote further investigation into a root cause. While these initial criteria can raise a red flag, laboratory testing of the oil provides an objective analysis of what is going on inside the gearbox. Lab testing will determine the particle count, amount of wear metals and contaminants, and measure the protective additives that remain in the oil. The industrial measure of viscosity, the Kinematic Viscosity at 40° C, is also tested as an indicator of how the oil is changing from its original grade- typically requiring a tolerance of 10% from the original specification. As viscosity changes with the amount of contaminants and wear metals, a trend on the Kinematic Viscosity will indicate a change over the sampling timeline while the Viscosity Index or the viscosity of the base oil, may actually remain unaffected.

It nearly goes without saying that where you take a sample is just as important as how the sample is taken. Without a representative sample of what is truly flowing through the gearbox, the laboratory tests might be inconsistent with the physical findings. For example, a sample taken after the filtering system can be absent of valuable data from the oil since filters are contaminant removers. Likewise, a sample drawn from the bottom of the gearbox may tend to show higher levels of debris and may not accurately represent the current condition of the unit. While each turbine manufacturer seems to have differing philosophies on where and how to sample the gearbox oil, the sample should be taken to ensure there is as much evidence as possible in each sample of oil.

Without argument, the best sampling location would be in a circulating system at a location downstream of wear components and before the filter system. Unfortunately, this is not how most wind turbine gearboxes are designed. Though it may be possible to independently operate the oil pump on some turbines to allow for a sample to be drawn while the oil is flowing, in many cases the turbine is shut down and has sat idle until the technician has climbed the tower to perform service work. This means that the oil has had time to settle and heavier particles begin to settle and stratify according to size and density, thereby compromising the quality of oil analysis.

More commonly, the gearbox is simply equipped with an oil sample valve and plug somewhere below the sump oil level. While this tap is probably the most prevalent oil sample location, using it to obtain a representative sample can have its drawbacks. Most significant is the fact that bottom sediment, debris and particles (including water) enter the bottle in concentrations that are not representative of what is experienced near or around the lubricated components. If it can be avoided, using the drain plug should be a method of last resort.

Although it is intrusive to the gearbox and exposes the system to potential contamination, a drop-tube vacuum sampling method can obtain a more representative sample on systems where operating a forced circulation system is not possible. Again, it is the technician's responsibility to ensure cleanliness of the oil whenever the gearbox is open, and this sampling method permits a tube to be inserted into the sump cavity where oil can be pulled into the sample bottle by a vacuum pump. Ideally the sample should be drawn from a point of about 50% level and as close to under the oil fed components as possible. Since gearbox sumps are designed to hold a large volume of oil, you would find the most concentrated contamination is on the bottom of the reservoir and the cleanest oil towards the top.

By just knowing the types of gear damage to look for, using a proper oil sampling process, and interpreting the physical properties of lubricating oil, a wind technician is able to identify common gearbox issues even before climbing down from the tower. Using these skills, they may even be able to save a turbine from continued damage that could result in total failure and extended downtime. A successful project should have documented sampling procedures that are followed uniformly by all team members. This ensures consistency in laboratory analysis and helps to structure the ongoing maintenance techniques of the project staff, especially for those who are new to the team.

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