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“Lubrication technology can not only improve the reliability of the assets but also get them to perform their best.”

▶ **Castrol committed to undertaking one of the most robust long-term lubricant tests carried out by a lubricants company. What was the main goal for this two-year field trial?**

We've always thought that there were efficiencies to be gained from lubrication technology. We've seen this in other industries. Until now, the data we collect has been translated into benefits for the equipment in terms of wear reduction, equipment reliability, and making them work longer. From an energy-generation standpoint, we had test results in the lab, and we wanted to see if we could replicate that in the field, because you can do all the testing you want in the laboratory, but you want to see what the real "seat-of-the-pants" feel is. We had a unique opportunity with a large Midwest wind farm, and we took it.

▶ **What were some of the general results from the field study?**

The big learning is the efficiency gained by using the latest Castrol high-performance drivetrain lubricants, which amounted to 0.72 percent more power compared to the competitive products. On the surface, that may not seem like a lot, but it's very significant in terms of energy generation. Based on the type of turbines that we used in the field study at that site, it amounts to approximately \$1,250 of additional revenue per year per turbine.

The turbines we used were on the smaller side compared to what's being produced today. So, if you use larger turbines, and if you have a site with a higher capacity factor — meaning, the wind blows higher and blows more in that area — your gains could be greater. We look at these test results as a conservative estimate. When you factor in that most of the cost has already been rolled into the turbine itself, that additional revenue just goes straight to the bottom-line in terms of profit for the energy producer.

▶ **Why do the results matter, and what impact does lubrication have on the performance of a turbine's drivetrain in general?**

Energy producers are always looking for ways to be able to

generate more power: How can we extract more from the wind? How can we take that and get more power to the grid? But then, they've got to balance that with investment cost. Our test results prove that we can leverage the lubrication technology to give them some of that benefit with little-to-no investment required. The turbines require lubricants anyway, so it's not something that has to be bolted onto the turbine or added on as an extra cost; it's something that's part of the routine maintenance. The results matter as they show how using advanced lubricant technology can drive profits for wind operators.

▶ **How did the journey to the field trial begin?**

We've done a lot of independent lab studies, as you can imagine. During our benchmarking process, we looked at different additive systems and compared them to competitive products that were out in the market. We started to see differences in terms of coefficient of friction. Along with coefficient of friction, we also looked at wear numbers, how much metal was removed, and vibration during test processes. When these certain lab tests indicate better performance, our minds instinctively go toward improving bearing life or gear life and equipment life. But when we wanted to look at how does that impact production, we needed to take that information a step further. We did a study with a European university and another large energy producer to do a full-scale demonstration of what's called a highly accelerated life test, or a HALT test.

That kind of test is solid because it allows you to control the variables and "keep the noise" to a minimum. It's really a strong data point to have in the process.

It works by using a full-scale rig — in this case it was 850 kW — a gearbox, electric motor, and generator arrangement where you control the power in and you can measure the power out. It's a great way to see what gets lost during the translation. In that test, we were able to log a 0.8 percent benefit just from changing the gear oils that were in the gearbox. That made us question, what else can we do with that? It's what really made us interested to take that into the field and see what happens.

Power meets Profits: How Castrol Lubricants Enhance Wind Turbine Output

A milestone trial result independently consulted and validated



Castrol's lubricant field study took two years to complete. (Courtesy: Castrol)

▀ What methodology was used to ensure the validity of the trial?

This is where we brought in industry experts, including an engineering firm, Wood PLC — to help us design this test. What was recommended was the side-by-side test method. It's a well understood process for being able to compare variables with turbines out in the field. It now sits within the IEC standard and is commonly used to compare control systems and blade adjustments, among other things. It essentially uses two turbines in very close proximity to each other to try to minimize the variables. That way, you can start to make the adjustments and see the resulting differences.

▀ Why was it important for third parties to independently validate the results?

We needed those industry experts to help guide us through this entire process. We (Castrol) can bring the lubricant technology expertise and speak to what we've seen in the lab and consider how we want to try and isolate certain results that have changed. They have the experience of consulting on all the other things needed for the field test. ONYX Insight was another consultant that did a lot of data gathering.

We gathered data for two solid years, but the entire process — from implementation and post-processing took the better part of four years. A big piece of that time was spent trying to minimize variables and filter all the data to find where the lubricants can impact production. We set up a test with eight different turbines — four of them running Castrol lubricants and four of them running competitive products.

We ran them for a year, and then we swapped the lubricants over. That way, we didn't just happen to get lucky picking the good turbines for the Castrol products and the not-so-good turbines for the competitive products. By tracking for a whole year, we also took some of that seasonal effect out. Considering seasonal impact really helps to ensure that you're comparing "apples to apples" as best you can.

ONYX compiled all that data, and then created a large technical report. Next, we brought in DNV — a well-respected name in the wind industry and across many industries — to audit and approve the process and the methodology. To qualify our results, it was important to get the correct trial setup as well as the correct analysis and audit process afterwards.

▀ Were there any findings that surprised you and your team?

I think comparing the field data to the results that we got from that highly accelerated life test was most surprising. We got 0.8 percent in that result, and we got 0.72 percent in the field study. There's going to be some noise in both of those results, but the numbers were close. I think it was cool to see that similarly to the bench tests, we could understand where losses occurred. We noticed that with the competitive gear oils, the gearbox oil temperature started to climb. As the energy goes through the system, not all of it makes its way to the generator; some of it gets lost to friction. The friction heats up the gear oil instead of going out to produce power.

▀ Based on the results of the field trial, what message would you like to convey to OEMs and wind-farm operators looking for ways to increase productivity?

It's great to be able to see how lubrication technology can not only improve the reliability of the assets but also get turbines to perform their best. Lubricants are part of the process and part of the requirement for the machines. Choosing the ones that can have the most impact and help improve the goal of energy production — with a low-cost or a no-cost — seems like a no-brainer. We now have the field results to back up how choosing the right product can help your equipment last longer and produce more power... and more profits. ↗

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