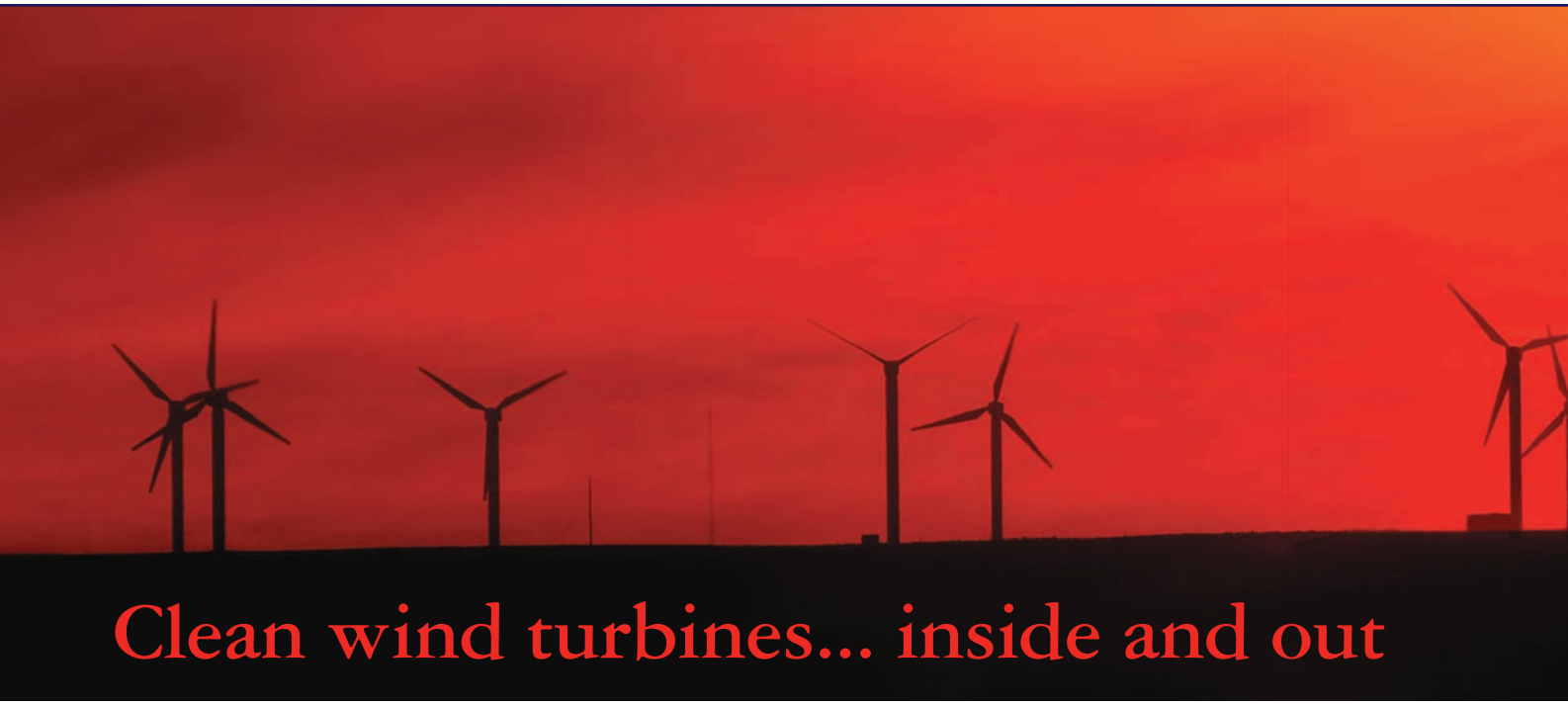

Clean wind turbines... inside and out

Daniel Alessandri, Strategic Marketing Manager for the power generation division of Pall Corporation, considers the effects of the weather on the wind energy sector

Roneklint, Denmark. Peaceful, sunny and green...what a change of pace from the horrendous past few weeks spent between Paris and England, all this in a matter of a two hour flight, and a one hour driving south from Copenhagen. Weather in Europe has been impossible to predict, impossible to like, and relentlessly extreme this summer. No need to work for the weather channel to notice; the downpours in England, the heat waves in Greece, and my wife remarking on the very mild "November" we just had in Paris.... Indeed it has been a summer for the record... and mostly for the worse. 'So this is what global warming does to us?' asked my daughter when another torrential downpour had, again, kept her inside the house.

It used to be that "talking about the weather" was just making conversation. These days it is the conversation. And these days, everyone is having that conversation. The public, the media, the industry at large, and revealingly the politicians have brought global warming, and more generally environmental issues to the fore. What a difference five years make... five years and a few instances of freaky weather patterns. So we seem to stand at the crossroads of the environmental revolution. Renewable energy, and especially wind power, stands at its core, and has gained tremendous visibility.

In tiny Roneklint, this conversation must surely have happened years ago. As you approach this green haven, a single windmill stands at a crossroads to produce local power (and incidentally serve as a beacon for lost drivers). It surprised me, not by its mere presence, after all this is Denmark, but by its small size, and its respectable age. There again, what a difference five years make. In the last decade or so, typical wind turbines have seen their capacity multiplied by a factor of 10, and some newer designs promise to break the 10MW barrier within a few years. In fact, the entire market has seen its metrics go through the roof: the size of installations is increasing, the demand for green power is increasing, the size of the market players is increasing and some say it is just the beginning.

Is wind power ready to take on the challenge and establish itself as the indisputable carbon-free technology in the medium term? Judging by the expected growth rate of wind generating capacity worldwide, many seem certain of it. But as the industry matures, as windmill capacity expands along with the size of the OEMs who build them, some new challenges emerge: some are political, some structural, some financial, and some are technological. Under pressure the market will surely evolve towards one concept: 'bigger and further'. Bigger because of the ever increasing size of the machines to lower generating costs. Further because the future of large-scaled wind energy depends greatly on offshore installations(including deepwater).

Unfortunately, years of experience with land-based MW size turbines have highlighted some key technical challenges that could prove deadly to the development of large wind turbines installations in more remote areas. One key issue is the reliability of the gearbox transmitting power from the rotor to the generator. Conference after conference, technical report after technical report, it is heralded as the biggest reliability issue, the largest operating cost contributor, and the toughest challenge for maintenance crews and operators of wind turbines.

Gearbox technology is by no means new, and it is the workhorse of most major manufacturing and processing industries, including transportation and power generation. Why is it then, that when placed inside a wind turbine nacelle, a gearbox the size of a car can fail after a few months, or even weeks, when its expected life is to be twenty years. While infant mortality rates can be greatly improved by design and manufacturing process improvements, rapid degradation of the gearbox in use is problematic in most, if not all turbine types, and across all manufacturers and operators. Evidently, the culprit lays in

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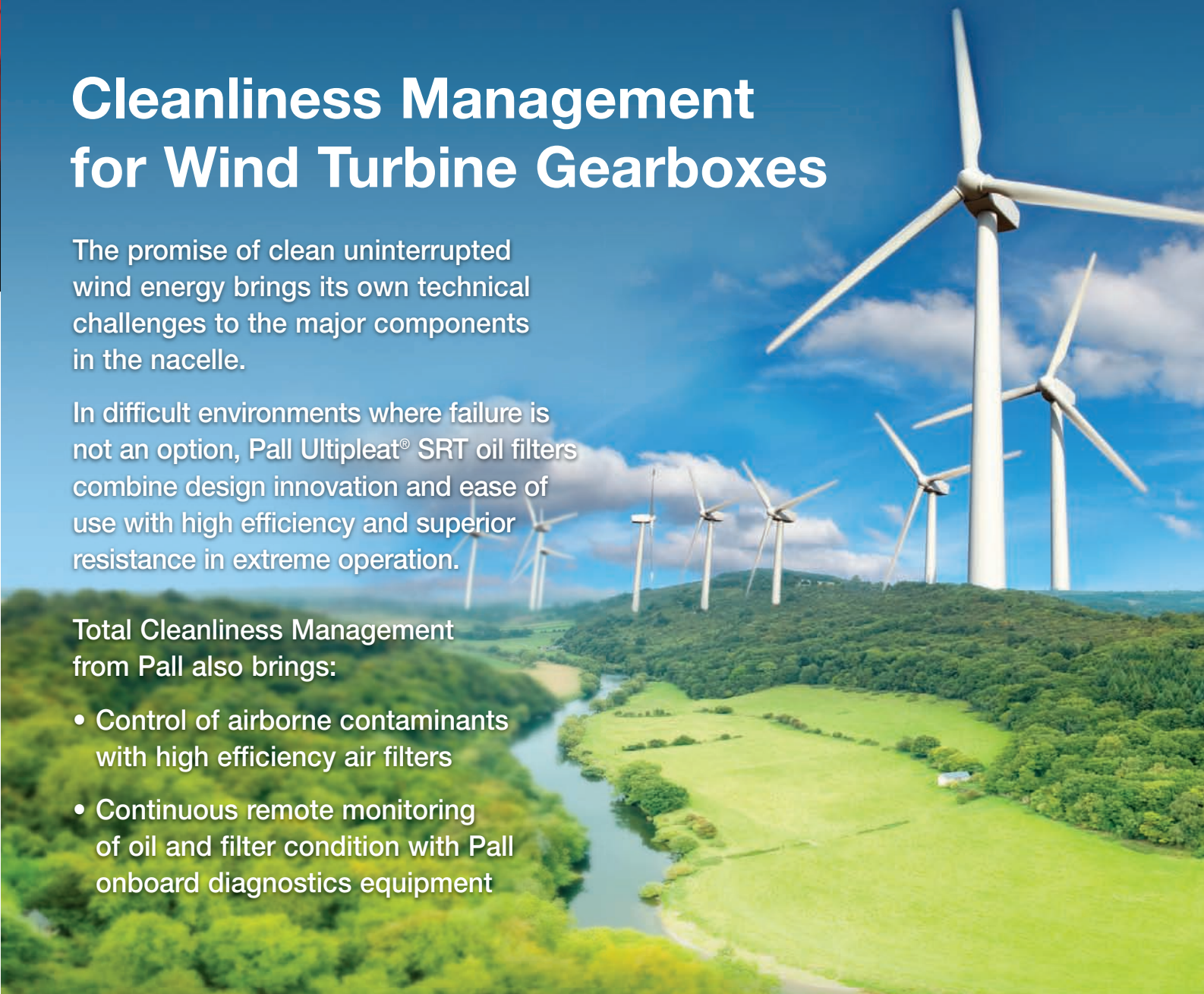

The promise of clean uninterrupted wind energy brings its own technical challenges to the major components in the nacelle.

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the application itself; Contrary to most industrial applications, a wind turbine gearbox is submitted to an ever changing input torque, or load, simply because of varying wind conditions. These rapid, high frequency load variations are almost impossible to compensate using typical pitch control systems, designed to adjust to macro changes in wind speeds. Hence the gearbox is constantly submitted to mechanical stresses more akin to a real life accelerated wear test than a typical steady state industrial application. Indeed, accelerated wear is what it's all about, and contamination in lubricating or hydraulic fluids is very often the cause.

To tackle this issue, most oil manufacturers developed fluids specifically design to sustain the atrocious conditions imposed on wind turbine gearboxes, from extreme temperature swings to severe mechanical stresses. A few years ago, AGMA (American Gearbox Manufacturers Association) defined a set of stringent cleanliness requirements for windmill gearbox lubrication. It also suggested the continuous monitoring of oil condition to detect problems long before their catastrophic consequences materialise. The filtration system is central to the issue, because it is the first protection for both the oil and the lubricated components like bearings and gear teeth. Filters are also consumable parts, and having to change one outside of scheduled maintenance interval costs orders of magnitude more in labor and downtime than the direct cost of the filter element. There is indeed an equal need for efficiency and reliability of the filter itself.

Current international filter testing procedures can fall short in predicting real life behaviour of a filter, especially in critical application such as wind generators (or highly cyclic applications such as injection moulding presses for example). Efficiency is measured through a standardised test in steady state condition, with constant contamination challenge, and very little mechanical stress imposed on the filter itself (1). Resulting is an efficiency "if everything goes as planned". Ask any windmill operator about the number of times things go "as planned" and you'll be able to judge of the relevance of such a test for real life prediction in extreme environments.

Pall has developed a set of testing procedures designed to challenge a filter element with varying stress and contamination challenge (2). And applied it to various filters with identical rating. Whereas efficiency was initially the same, it varied by a factor of 50 at the end of the test. The findings allowed Pall to develop a totally new filter design called SRT (for stress resistant technology) able to maintain very high efficiency throughout the life of the filter, even when submitted to high mechanical stresses. It is now embarked on some of the most advanced windmills, ensuring that the gearboxes can live past their teenage years. It is a sustainable filter for a sustainable energy source.

I can still see the venerable Rodelink windmill. Next time my daughter asks, I'll tell her that what matters is not so much what global warming does to us, but what we are prepared to do to it... and every little thing helps, including dealing with the microscopic particles wreaking havoc in a gearbox. ■

Daniel Alessandri is strategic marketing manager for the power generation division of Pall Corporation, a worldwide leader in separation and purification technologies, and is responsible for the development and positioning of fluid management, purification and filtration products and services to the power generation industry. Daniel holds a BS in energy and propulsion engineering from the National Institute of Applied Sciences in France, a MS in mechanical engineering from the University of Connecticut and a MBA from New York University Stern School of Business.

For further information please visit www.pall.com

(1) ISO16889 Standardized multi-pass filter performance test
(2) Based on SAE ARP 4205