IN FOCUS: Wind Power

BELZONA®
Repair • Protect • Improve

LONG-LASTING, IN-SITU-APPLIED AND EROSION-RESISTANT SOLUTIONS

Leading New Technology

Wind Power is currently leading the way in the Renewable Energy Sector and is considered to be one of the largest sources of clean energy in the world. By 2022, predictions estimate that Wind Power will have a global capacity of 800GW.

Consequently, it has gained global attention with hundreds of billions of dollars invested into the sector each year, making it one of the world's fastest growing industries.

By the end of 2015, Wind Power was producing 3.7% of global electricity and by 2016, there were over 340,000 wind turbines in operation around the world. A figure which will only increase as technology continues to improve and Wind Power grows in prevalence.

Problems Facing the Industry

One of the greatest problems facing the Wind Power industry is the maintenance of the turbines themselves. Ceasing energy production and dismantling the turbines for repairs can be a costly and lengthy procedure. The average wind turbine is made up of 8000 different pieces which can experience a range of maintenance issues. This can be due to environmental damage, erosion and corrosion, amongst other reasons. Offshore wind farms pose further issues; as well as the harsher environment, in-situ maintenance is also more difficult to perform. In this In Focus, we will be looking at these issues in further detail and how Belzona's wear-resistant materials can repair and provide future protection against them.

Where Does Damage Occur?

One way to best understand the different issues wind turbines can experience, is by splitting them up into three main areas:

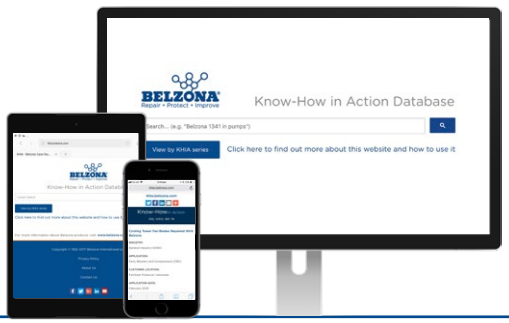
- **Nacelle**
- **Blades**
- **Tower/Transformer**

Belzona Know-How *in Action*

Want more information on any of the case studies featured in this In Focus? You can find them all at: **khia.belzona.com**

Then click on *'View by KHIA series'* and sort by volume and number.

On **khia.belzona.com** you can search through Belzona's entire library of case studies!



Issue 117

Contents

PRODUCT SELECTOR

BLADES

Belzona 1331/
Belzona 1341 (Supermetalglide)
Roller or brush-applied coatings for protecting fibreglass from the effects of erosion

SHAFT

Belzona 1111 (Super Metal)
Fully machinable repair composite which requires no specialist tools and will bond to almost any surface

Belzona 1212
Surface-tolerant, multi-use repair composite which adheres to many substrates and experiences rapid cure times

BASE

Belzona 3100 Series
Hand-applied waterproofing membrane systems for the repair and protection of structures

Belzona 3412
Sprayable or brush applied flexible encapsulating membrane which is peel and resealable for ease of maintenance

Belzona 4000 Series
Concrete rebuilding and resurfacing materials with outstanding chemical and abrasion resistance

Belzona materials are:

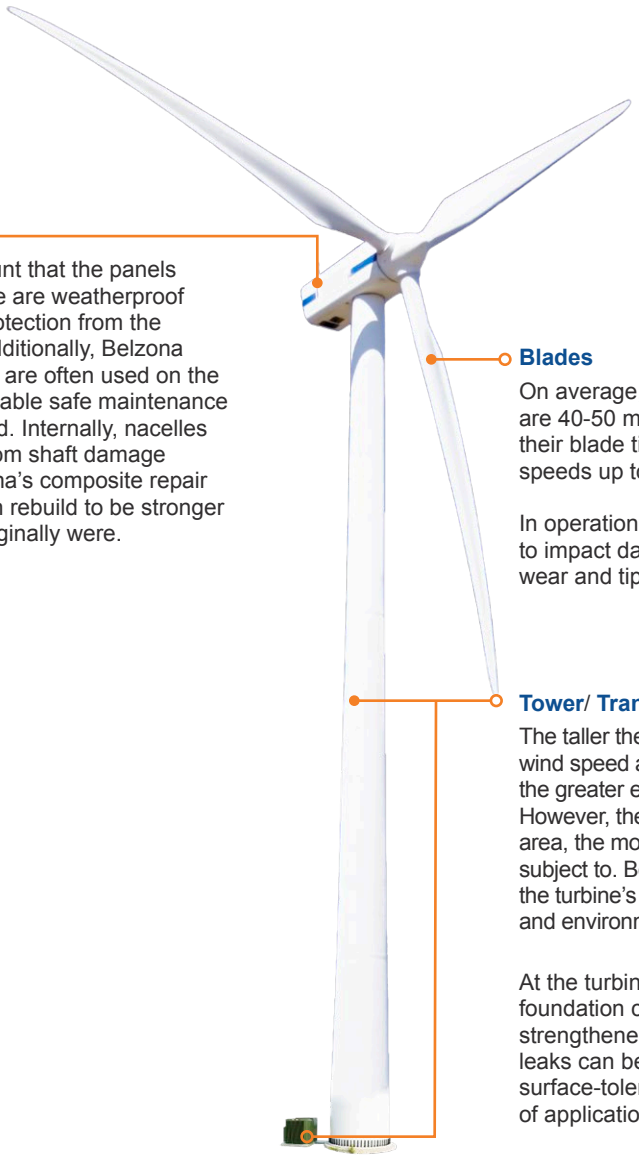

Easy to apply


Erosion resistant


Cold applied
No hot work


Durable

PROBLEM AREAS



Nacelle

It is paramount that the panels of the nacelle are weatherproof to ensure protection from the elements. Additionally, Belzona grip systems are often used on the nacelle to enable safe maintenance going forward. Internally, nacelles can suffer from shaft damage which Belzona's composite repair solutions can rebuild to be stronger than they originally were.

Blades

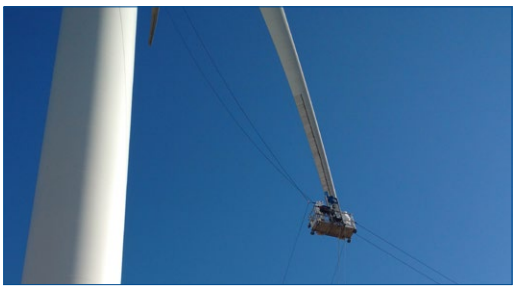
On average, wind turbines' blades are 40-50 metres in length and their blade tips can revolve at speeds up to 190mph (300kmph).

In operation, these are subject to impact damage, leading edge wear and tip damage.

Tower/ Transformer

The taller the turbine, the higher the wind speed at the top and therefore the greater expected power. However, the larger the surface area, the more damage the tower is subject to. Belzona's coatings protect the turbine's tower from corrosion and environmental conditions.

At the turbine's base, the concrete foundation can be repaired and strengthened. Any transformer leaks can be addressed with surface-tolerant systems for ease of application.


Blade protection with Belzona 1341
VOL. XXXII, NO. 142


Tower repair with Belzona 1211
VOL. XXXII, NO. 33


Repair within the **Nacelle** using Belzona 1131 (Bearing Metal) **VOL. XXXII, NO. 48**

Transformer repair with Belzona 1212
VOL. XXXII, NO. 18

60 WIND TURBINE BLADES PROTECTED

Asset owner required durable LEP *(Leading Edge Protection)* to prevent future erosion damage

VOL. XXXII, NO. 111

Turbine Blade Damage

Leading Edge Erosion (LEE) is one of the main forms of damage wind turbines experience. This is due to the speed at which the blades rotate, which creates immense pressure at the blade tips, as well as additional impact and abrasion (from rain, dust, ice, hail, insects, birds and lightning amongst others). If left unprotected, LEE can leave blades unbalanced, affecting the shaft and gearbox and resulting in efficiency loss.

Case Study

A wind farm in Québec, Canada, required protection for the leading edges of 60 wind turbine blades. The blades were deteriorating due to rain/environmental erosion, which was impacting the performance, energy output and ultimately - the life expectancy of the turbines.

The Asset Owner had hinted on some performance issues from the previous LEP coating but their main issue was that it was difficult to apply. Therefore, they wanted to try a different option which would provide both high performance and ease of application.

It was decided to use Belzona 1341 (Supermetalglide). This material is often specified for LEP due to its easy application process by roller or brush and its strong erosion protective properties. Its performance and durability would be superior to the existing coating and also prevent the damage from escalating.

Application details

The application began with the blades being brought to a workshop for previously planned general maintenance. The eroded substrate was pitted and the gel coat had experienced surface loss. A filler product was used to rebuild these to the correct dimensions. The surface was then roughened with a mechanical sander and cleaned. Once prepared, a single coat of Belzona 1341 was applied by roller to an average thickness of 12 mils.

Throughout the whole application, Belzona personnel provided on-site support. This gave the Asset Owner further confidence in Belzona. Additionally, the ease of application (in comparison to the previous coating) meant that the Asset Owner expressed the possibility of future applications based on the performance of the Belzona 1341.

Belzona applied by roller to the Leading Edge

Close up of the Belzona 1341 application

The whole blade completed

Belzona personnel were on site for support

BELZONA REPAIRS OIL LEAKS ON WIND FARM TRANSFORMER

VOL. XXXII, NO. 112

Transformer

Problem:

- A wind farm's transformer was leaking oil through the main flange and bolt holes.
- It was estimated that 120 bolts were leaking.
- The Asset Owner only had a five-day window to repair the leakage and prevent it from happening again.

Before

Belzona Solution:

- Stainless steel caps were fabricated to fit over the bolt heads and the nuts.
- The gap between the transformer body and top cover was filled with Belzona 1161 (Super UW-Metal). This material displaces fluid from surfaces and therefore can be applied to wet or oily substrates.
- The caps were then filled with Belzona 1161 and clamped onto the bolt heads.
- The whole repair was coated with Belzona 5811 (Immersion Grade) which would protect it going forward from the effects of hydrocarbons and the environment.

After

BELZONA SEALS WIND TURBINE TOWER BASE AGAINST WATER INGRESS

VOL. XXXII, NO. 93

Problem:

- Rainwater and moisture were seeping into the ground and consequently into the wind turbine structure.
- This was affecting the concrete and creating cracks and corrosion at the base of the tower.

Before

Belzona Solution:

- Belzona 3111 was an easy way to seal the base of the structure and the concrete.
- The application was simple to do and gave the Customer extra flexibility in that area.
- This proved to be a cost-effective solution with minimal downtime or interruption to the operation of the turbine.

After

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IN-SITU SHAFT REPAIR

Belzona saved the asset owner hundreds of thousands of dollars thanks to in-situ repair

VOL. XXXII, NO. 92 ↗

Shaft Damage

At a Texas wind farm, when one of the wind turbine's shafts became damaged, the concern was that the whole turbine would have to be dismantled and brought down for maintenance.

The shaft, located in the nacelle, was not properly grounded. This was causing significant electrolysis corrosion and consequently was destabilising the whole turbine.

Original Replace and Repair Options

It was decided that shaft needed to be either replaced or repaired. Originally, two options were considered but both cost hundreds of thousands of dollars and would have incurred downtime of 2-3 weeks for the turbine.

Option 1 was to replace the generator shaft for approximately $300k.

Option 2 was to dismantle the shaft and bring it for repairs by welding at a workshop. This would have had a similar cost of $275k

Option 3 Belzona System

The customer was familiar with Belzona solutions and therefore the Belzona 1111 (Super Metal) was chosen to rebuild the original shaft to the correct dimensions. Additionally, should the shaft become ungrounded again, Belzona 1111 does not corrode and therefore the same issue would not occur.

Application of Belzona

For this application, it was necessary to firstly fabricate two formers to clamp around the shaft. These were made out of brass, to the exact dimensions of the shaft.

Then, Belzona 1111 was applied to the shaft and the formers (coated in the release agent - Belzona 9411) were clamped around it. Upon curing, these were removed to be used again and the shaft was restored.

In total the application, including the Belzona materials, cost less than $10,000, a fraction of price of the alternative solutions. As well as this, the customer was highly impressed with the results of the application. Consequently, the Energy Company decided to standardise this repair method across all of their wind farms and ten differently sized brass formers have been created to repair different shafts.

The electrolysed shaft beforehand

The repaired shaft after

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