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Opening photo: Some Exkal refrigeration systems installed in a supermarket.



FOCUS ON TECHNOLOGY

**Paint more, better and cheaper:
The milestone reached by Exkal with
Nordson's patented HDLV powder
coating pumps, which use dense phase
technology and intelligent design
of the painting line**

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“The sustainable path is evolution, change and adaptation”. With these words Exkal explains its global brand, a company based in Marcilla (Navarra, Spain) founded in 2005 with the goal of becoming the technology leader in the field of industrial refrigeration (**Ref. opening photo**). Faithful to this concept, the company is moving rapidly towards the Industry 4.0, simplifying, balancing, synchronising and minimising anything that does not add value to the product. Exkal is evolving its production processes, from the working of sheet metal to painting and all the way to logistics, towards flexibility, quality and the reduction of delivery times, gradually increasing automation and interconnecting processes through the “Internet of Things” in order to convert the collected data into information that is useful for continuous improvement. “In the 2014-2016 management plan the company planned investments of about 8 million euros both in facilities and personnel to triple production, reaching a total of 60,000 refrigeration appliances per year”, explains Miguel Fernández, production engineer at Exkal. A major portion of this investment was for painting because it was a bottleneck for us: the first line, with a monorail conveyor and a single spray booth, was fully maximised with three shifts and had no room for an increase in productivity. At the end of 2014 Exkal approved an investment in a coating line that was on the cutting edge for pre-treatment, paint application and handling of parts with the aim of increasing production capacity and quality while reducing costs”.

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To achieve this ambitious goal Exkal defined three approaches:

- Replace classic pretreatment with a nanotechnological process.
- Implement a power and free conveyor and a layout designed to provide maximum flexibility and productivity, reducing downtime on the line to zero.
- Adopt the most innovative system of powder coating application available today, namely dense phase HDLV pumps for conveying the powder and Nordson Encore HD application equipment for total control of the process.

“For Exkal repeatability, uniformity and reliability over time are critical. The Nordson technology with Encore HD guns and HDLV pumps guarantee such a result.”

The consortium of companies that designed and supplied systems and equipment according to Exkal specifications included Geinsa (**Fig. 1**) for the painting system, Futura Convogliatori Aerei for the conveyor and the design of the line’s logistics, Proquimia for the process chemistry, while Nordson was the brand of the systems and application equipment that offered the product characteristics and service best aligned with Exkal’s needs with regard to application, efficiency and quality of the coating. “At Exkal we paint using a lean system, order by order. This means that when we start working on an order for a new supermarket, for example, the furniture is painted in various stages, even months apart”, explains Fernández. “So for us repeatability, uniformity and reliability over time are critical. The Nordson technology with Encore HD guns and HDLV pumps guarantee such a result”.

Zero downtime with a superflexible layout and superautomated colour changes

The layout of the new Exkal coating line is extremely flexible. The starting point for the project were three work shifts and 40 colour changes per day. The goals were to double production reducing downtime during colour change, improve quality and have a robust control over the process. The current line has made it possible for the company to reach a downtime equal to zero during colour change, reducing shifts to one and a half. Thanks to the Futura power & free conveyor system (**Figs. 2 and 3**), the addition of twin Nordson



Figure 1: The consortium of companies that designed and supplied systems and equipment meeting Exkal’s specifications included Geinsa for the paint system.



Figure 2: The power & free conveyor system from Futura Convogliatori Aerei.



Figure 3: Detail of the power & free conveyor system from Futura Convogliatori Aerei.

ColorMax 3 booths in parallel (**Fig. 4**) and the strategic positioning of overflow areas before and after the booths it is possible to either paint two colours at the same time or use one booth for painting while changing colour in the other. Any colour can be painted at any time with total flexibility (**Fig. 5**).

Thanks to the HDLV powder coating pumps that use dense phase powder technology, which allows for a better control of coating and automatically performs many stages of system cleaning, the time to change colours has been reduced to four minutes. “The HDLV pumps provide great application accuracy, perfect adjustment of the thickness, increased layer uniformity, greater penetration and, above all, increased process

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repeatability. In a few months, by using the same application parameters, you can get the same painting result”, begins Sebastián González de Zárate,

Area manager of industrial coating systems at Nordson Ibérica.

“This is because dense phase technology does not use Venturi but rather HDLV pumps that require only a small amount of compressed air to convey the powder at low speed. This allows greater application accuracy and total control of the process. Furthermore, it also helps to decrease colour change times because all the cleaning of the circuits, the fluidised hopper and the system is automatic”.



Figure 4: The twin Nordson ColorMax 3 powder coating booths in parallel.

How does dense phase work?

“What sets the dense phase apart from the traditional Venturi powder coating system is how the powder is conveyed to the guns, which is done with very little compressed air. The electrostatic system loads

just the powder to be conveyed to the piece and is therefore much more efficient”, continues González de Zárate.

“Essentially the dense phase pumps are dosing the powder. While in Venturi systems the amount of powder supplied depends on the increase of compressed air, in dense phase the control of the powder intake is independent of the amount of compressed air. The HDLV pump uses a tube having an inner diameter that is only 6 mm which makes it possible to carry twice the amount of powder compared to the Venturi system. Nordson’s Spectrum HD powder centre is fed with new powder by a high-capacity HDLV pump working continuously, mixing it with recovered powder. Level sensors monitor the fluidised hopper to verify the intake of new powder as needed”.

In the Nordson Spectrum HD powder centre (Fig. 6) both the new powder and

the recovered powder pass through an ultrasound sieve that ensures the quality of the finish. During colour changes the dense phase pumps execute an automatic cleaning of the powder circuit for a few seconds, first blowing out the section between pump and gun, then the section between the pump and the fluidised hopper. In the meantime two operators clean the booth. The recovered powder returns to the fluidised hopper, where it is sifted. The fluidised hopper is completely emptied by means of a valve and the powder is pumped into the container, then the HDLV pumps automatically clean the powder suction line. In this phase compressed air is injected into the fluidised hopper and suction is set at maximum power. This way the Spectrum HD powder centre is automatically cleaned, considerably reducing colour change times.

The PowderPilot HD with command touch screen (Fig. 7) shows the data on the amount of powder and air in use, making it possible to control the system’s operation at any given moment, to check online for compliance with assigned application values, to control the suction unit, the Spectrum HD colour centre and the powder level sensors, as well as activating the HDLV recovery pumps, the HDLV new powder coating pumps, the ultrasound sieve and suction. Alarm sensors alert the operator of possible malfunctions in the system or drops in set parameters. The suction system is a compact double cyclone, a Nordson design that guarantees a higher recovery efficiency. It has inspection windows and the sieve is removable so it is easier to clean. A high-capacity dense phase pump (up to 4 kg/min) carries the recovered powder to the powder centre. This way the cyclone is never saturated.

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Figure 5: With the new layout, it is possible to paint two colours simultaneously, or apply one colour in a booth and change colour in the other. Any colour can be painted at any time with total flexibility.

Line Characteristics

Exkal paints galvanised sheet metal with a maximum size of 1800 mm in height and 400 mm in width and with a speed of 3 m/min. This industrial system includes, among other equipment, a surface treatment tunnel with degreasing/hot nanotechnology steps; washing with demineralised water; passivation at room temperature; demineralised water plant and oil separator. In addition, the industrial facility includes a humidity drying oven; IR gelling oven; polymerisation and painting oven; chain for overhead conveyor and electrical cabinet with general mimic panel, PLC and touch screen. The surface treatment tunnel is situated within the complex. It is a closed area - 36,500 mm long, 1,400 mm wide and 3,900 high - covered with stainless steel sheets, which eliminates any possibility of formation of oxides. The structure consists in sheet metal

panels assembled using a special system of construction without welds. It has a closing system in the roof that uses brushes to prevent vapour from reaching the conveyor. At the tunnel exit there are two forced blowers directed in such a manner as to eliminate water particle from the surfaces of the pieces, with the objective of reducing the amount of deposited water present before introducing the components into the humidity drying oven.

Finally, the paint system installed at Exkal is equipped with an electric control panel that includes a touch screen and mimic panel representing the entire system, depicting the

elements operating on the line with LEDs that start flashing if there are problems.

The burners installed in the humidity drying oven are of the direct flame type, while the polymerisation oven uses indirect flame modulating burners with a refractory AISI-310 stainless steel combustion chamber.

“The only way to achieve good productivity was to have two spray booths painting in parallel”, says Miguel Fernández. “On average our refrigerating machines have 4 colours, always chosen by the customer. Our philosophy is to paint to order, this means an average of 20 colour changes per shift. With the first line, the average was eight minutes to change colour, a huge amount of lost production time”.

“This coating line is designed to work according to the concept of Industry 4.0”, continues Miguel Fernández. A sensor system controls the pretreatment

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Figure 6: The Nordson Spectrum HD powder coating centre.

automatically, adding product only if needed. Compared to the previous measurement performed manually once a day, we now have greater traceability of parts and can guarantee that there will be no quality problems. Thanks to this system and the introduction of nanotechnology, we went from 500 to 1000 hours of salt spray resistance”.

Similarly to the pretreatment, the powder coating (**Fig. 8**) is also perfectly controlled thanks to the use of HDLV pumps. “The paint layer is 60 ± 5 microns. We lose very little powder and have a film that is uniform and well spread. Even though the system has been in operation only since January 2016, the data show a savings in powder of around 10-15% for the same coating and production volume”. “When it comes to savings in powder, Exkal is penalised by the number of colour change made during the day”, clarifies Sebastián González de Zárate of Nordson. “Furthermore, the percentage of



Figure 7: The PowderPilot HD with command touch screen from Nordson's HDLV system.

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Figure 8: Application of the coating powder using Nordson Encore HD guns.

savings varies depending on the starting point of each company. Those that replace a sheet metal booth and a Venturi system with a plastic booth and Nordson HDLV application can achieve savings of 40%”.

Conclusions

“The painting line is just the first step of our investment plan”, concludes Miguel Fernández. “The next phase - even more ambitious - is an internal logistics system that allows us to direct every outgoing carrier from coating to a specific area for a predefined time, and then send it from there to the assembly line only when it is needed so that nobody touches the pieces after painting and before assembly, thereby preventing any damage. For this second phase of the

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investment plan, which is the core and more complex part of the project, we have again chosen to work with Futura Convogliatori Aerei. In general, for all this modernisation of the production process we have chosen to work with suppliers that can understand our complex process and transform the ‘dream’ of Exkal from paper to reality”.

“It is not just a matter of supplying a product, but rather being part of a very large and complicated project, in which suppliers must be able to coordinate with each other at all times. Suppliers that were chosen for the added value that they can bring to the investment, not simply because they offer the best price. We chose Nordson for the quality of the dense phase system and for its assistance, the human support and advice that it is able to offer”.

“Our product is a product with a high level of technological development: our suppliers were chosen based on the improvements that they have been able to make to their technologies, for their attention to detail and because they are focused on the realisation of the Industry 4.0”. ○