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Opening photo: The LU-VE Group has been producing heat exchangers for the commercial and industrial refrigeration and air conditioning sectors since 1986.



FOCUS ON TECHNOLOGY

A Nanotechnology Pre-Treatment Process for Heat Exchangers: The Sustainable and Innovative Choice of the LU-VE Group

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Finishes play a primary role in the choice of a product. In some industries, however, manufacturing a high quality object means to find the right combination of surface protection and aesthetics. In sectors such as the automotive and refrigeration ones,

where complex-shaped metal components are hidden inside bodies and fairings, treating each element correctly is mandatory to guarantee the functionality and usability of products.

This is the case of the LU-VE Group, one of the

largest manufacturers of air heat exchangers in the world. It operates in different market segments: commercial and industrial refrigeration, process cooling for industrial and power generation applications, civil, industrial, and precision air conditioning,

and glass doors and closure systems for refrigerated counters and display cabinets. LU-VE has succeeded precisely in combining aesthetics and functionality: since 1986, it has been coating in-house its products with different tints (mainly white, the colour of cleanliness) and, recently, it has installed a new nanotechnology pre-treatment plant to improve the anti-corrosion protection of their surfaces.

The LU-VE Group

“Its focus on innovation, its constant commitment in the research and development of new technologies, and the high quality of its products have allowed the LU-VE Group to immediately establish itself as a leader in the production of heat exchangers for the commercial and industrial refrigeration and air conditioning sectors (ref. Opening photo),” states Chief Communications Officer Fabio Liberali. “LU-VE is an international business with 16 production plants in 9 countries: Italy, China, Finland, India, Poland, Czech Republic, Sweden, Russia, and the USA. The Group has over 3,000 qualified employees (1,000 of whom work in Italy)

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Figure 1: The show room located at the headquarters of the Group in Uboldo (VA).

and plants covering 570,000 m² of surface. We export 83% of our production in 100 countries. In 2018, our pro-forma turnover was more than 420 million Euros. Our R&D laboratories are among the largest in the industry and we collaborate with various universities and international research institutions, starting from Politecnico di Milano. We were among the first in our sector to implement environmentally friendly production and product technologies. The success on the international market of the LU-VE Group stems precisely from these choices. Its advanced R&D policy is based on the fundamental principles of environmental protection: reduced energy consumption, reduced use of coolants, low noise levels, high reliability in time, and limited dimensions,” says Liberali.

The production process

ipcm® has had the opportunity to visit the headquarters of the Group, located in Uboldo (VA, Italy - Fig. 1). “The productive activity of this factory is mainly focussed on ventilated machines such as evaporators, capacitors, and dry coolers (Fig. 2) intended for the sectors of commercial and industrial refrigeration, process cooling for industrial

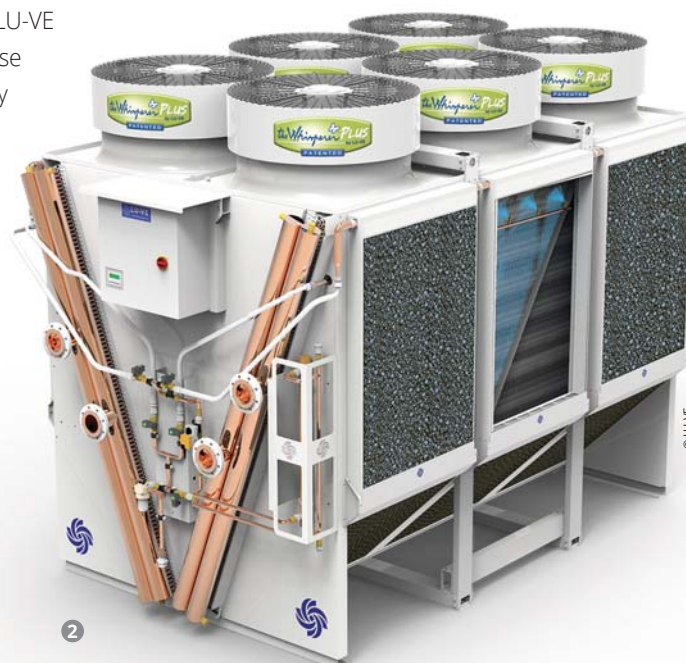


Figure 2: The productive activity of the factory is mainly focussed on ventilated machines such as refrigerators, capacitors, and dry coolers.



Figure 3: After machining, the galvanised sheet metal fairings are sent to the pre-treatment tunnel.

and power generation applications, and civil, industrial, and precision air conditioning. Finned heat exchangers are the core of these machines,” explains Quality Manager Angelo Borroni. “They are batteries consisting of louvred fins and manifolds made in-house by machining aluminium (or copper) coils and of copper (or aluminium) tubes. Correct assembly between two complementary fins enables the coolant flowing in the copper pipes to come into contact with the air in the battery, thus generating heat exchange.”

“We also produce in-house the galvanised iron fairings that constitute the frames of our machines (**Fig. 3**). During assembly, we then add brackets, electrical connections, and transmission systems. The last phases are packaging, storage, and shipping,” says Borroni.

“Finally, our factory includes a department that manufactures precision air conditioners intended for operating rooms, clean rooms, data centres, web farms, and telephony service providers,” adds Liberali.

Environmental sustainability and Industry 4.0: the investment made by LU-VE

“Chemical pre-treatment is a key process in order to provide our refrigeration and conditioning systems with optimum quality in terms of both corrosion protection and aesthetic value: without it, the coating applied could delaminate or lose its colour over time. Our factory is equipped with two different systems: a spray one dedicated to the pre-treatment of external components and an immersion one for internal components to be assembled on bodies. The choice of installing two different solutions was motivated by the different nature of the materials we treat (black iron for internal components and galvanised iron sheet for the external ones),

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their complex shape, and the large dimensions of some of them. Thanks to our collaboration with DN Chemicals, the company formed by the merger between the Surface Treatments Division of Dollmar Spa with Noxorsokem Srl, and Soft Rain¹, we have now installed a new pre-treatment plant.”

“The choice to replace both the phospho-degreasing systems of the Uboldo factory was primarily due to the company’s focus on environmental sustainability and safety. Both plants worked very well and allowed achieving optimal quality results, but their baths were too aggressive, using large quantities of chemicals and generating waste products such as fumes and sludge. That is why we decided to replace them. As for the line treating galvanised sheet metal, we relied on two leading technological partners: DN Chemicals, which supplied us with its Dollcoat SA115 nanotechnology solution, and Soft Rain (Fig. 4).”

¹ P. Angeli, A. Paganelli, *Synergies to Achieve total Pre-Treatment Quality: Soft Rain and MacDermid’s New Partnership*, *ipcm® International Paint&Coating Magazine* no. 36 (November-December 2015), pages 44-47.



Figure 4: A detail of the Soft Rain system.



Figure 5: The Soft Rain Avantgarde system was integrated into the tunnel as an innovative technology for the mixing of the nanotechnology solution.

The new 7-stage pre-treatment tunnel

“The new pre-treatment cycle includes seven stages, i.e. two active baths and five rinses with osmotised water. The Soft Rain Avantgarde system was integrated into the tunnel as an innovative technology for the mixing of the nanotechnology solution (Fig. 5),” adds Borroni.

Andrea Paganelli, the owner of Soft Rain (Poggio Torriana, RN, Italy), lists the main advantages of the Soft Rain Avantgarde system:

- nebulisation of always fresh nanotechnology solution;
- nanotechnology product consumption optimisation;
- performance consistency, as the parts are always treated with the same amount of nanotechnology solution;
- no waste water to be treated;
- recovery of the excess nebulised product, which is recirculated into the pre-treatment process;
- no product dripping or dragging;
- autonomous dosing of the powder amount needed for each cycle.

“The nanotechnology solution chosen for this pre-treatment process is Dollcoat SA115, developed by DN Chemicals. The characteristics of the synthetic oligomers obtained from silanes improve the paint adhesion and corrosion resistance properties of the treated surfaces. Furthermore, this product is free of heavy metals and resins and, therefore, environmentally sustainable and safe for the health of operators.”



Figure 6: The nebulisation of the Dollcoat SA115 nanotechnology product developed by DN Chemicals.

“The nanotechnology solution chosen for this pre-treatment process is Dollcoat SA115, developed by DN Chemicals (Fig. 6). The characteristics of the synthetic oligomers obtained from silanes improve the paint adhesion and corrosion resistance properties of the treated surfaces. Furthermore, this product is free of heavy metals and resins and, therefore, environmentally sustainable and safe for the health of operators,” says DN Chemicals sales director André Bernasconi.

Final production stages

“After pre-treatment, a one-rail overhead conveyor takes the workpieces to a drying oven and a Wagner Itepowder coating booth equipped with eight reciprocators (Fig. 7). If necessary, this is followed by a manual retouching operation on the most difficult-to-reach areas, where the paint may not adhere properly.

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“Both the pre-treatment plant and the coating booth were developed following the Industry 4.0 principles upon LU-VE’s request. When coating large-sized products, i.e. over 5 metres long, being able to track and control the parameters of each process phase is crucial to guarantee a high quality product.”

the Industry 4.0 principles upon LU-VE’s request. When coating large-sized products, i.e. over 5 metres long, being able to track and control the parameters of each process phase is crucial to guarantee a high quality product. “Finally, the pre-treatment plant is equipped with a HMI interface that monitors the process and enables the parent company to remotely connect and intervene in real time to solve any problems,” says Borroni.

Effective collaboration

“We are very pleased with the investment made, as the characteristics of our pre-treatment plant guarantee safety and environmental sustainability, two critical values for the LU-VE Group. The only technical issue that we have encountered concerns the amount of paint needed to cover edges and notches. Our next step will be to integrate the application of a base coat, thus switching to a two-layer system. In the near future, we will also assess a new nanotechnology product that DN Chemicals is currently developing, which will allow reducing the current loads that cause corrosion and evening out the surfaces treated through a network of nanotubes, thus enabling the paint to adhere correctly and uniformly to the whole part,” states Borroni. This product is still in the development stage, but it will be soon available on the market. ○

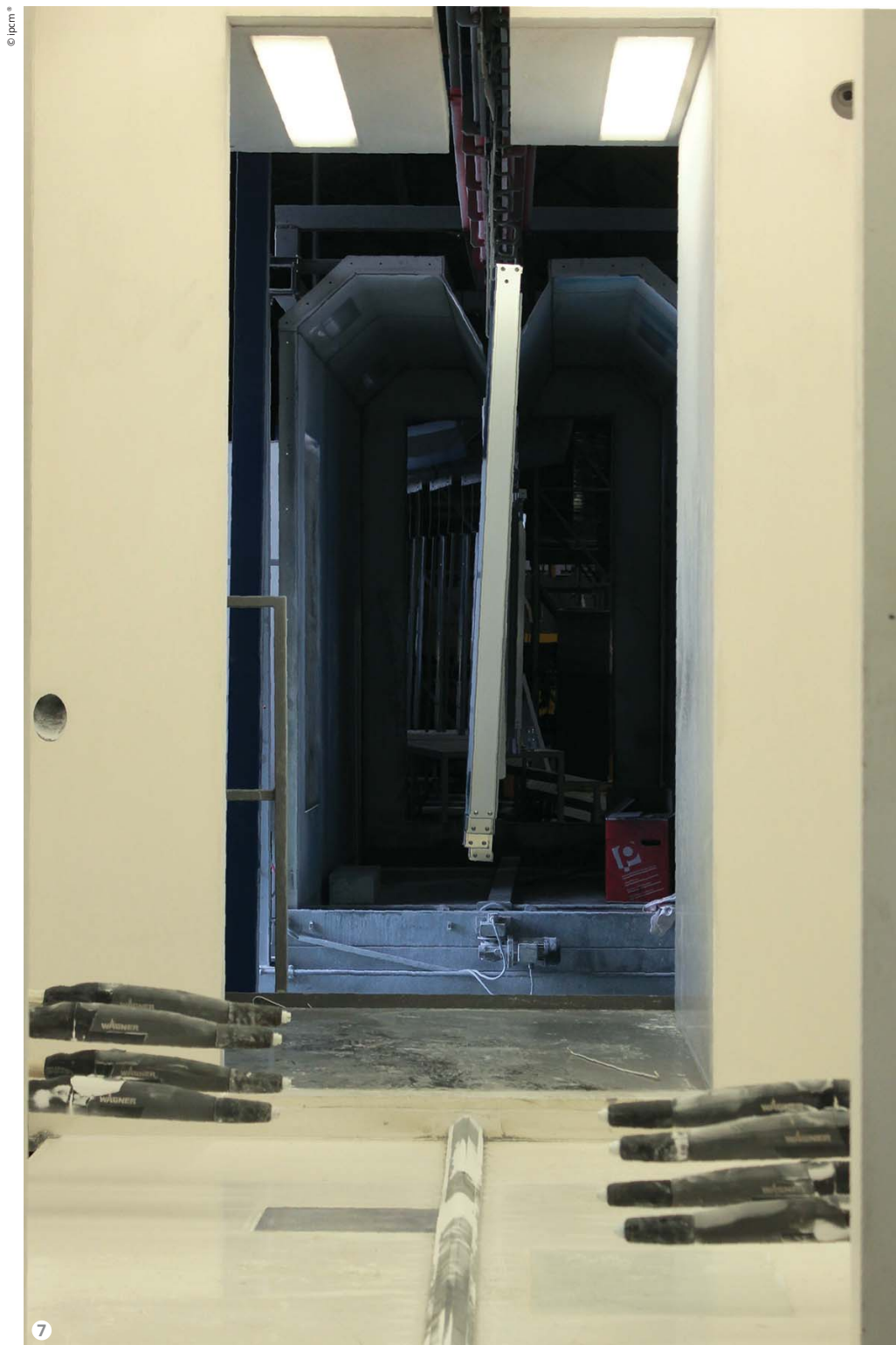


Figure 7: The Wagner Itep spray paint booth is equipped with eight reciprocators.