



Zelle-engineering produces forged aluminium alloy wheels for the aftermarket and original equipment sectors as well as for limited edition vehicles.



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Zelle-engineering Chose to Electrify Its New Coating Plant for Zero-Emission Production of Forged Wheels

Monica Fumagalli **ipcm**[®]

The decision to power its new coating system exclusively with electricity is at the core of the environmental vision of Zelle-engineering, a company specialising in the design and production of high-end aluminium alloy forged wheels. To realise its sustainable plant engineering project, the company turned to Tecnofirma, a specialised surface treatments company.



The loading area of the pre-treatment tunnel's overhead conveyor.



The 13-stage pre-treatment tunnel.

The manufacturing industry is at the heart of the world's energy issue, which calls for the need to transition to less impactful solutions. Whereas "going electric" is one of the most popular trends of the moment, from domestic energy to cars, since today electrically powered engines are the most popular alternative to internal combustion engines, in the industrial sector replacing methane gas powdered systems with electrically powered alternatives is still a path taken by a limited number of companies, due to the high costs entailed and the necessary changes to be made in the plants involved. Methane, the cost of which has soared in recent times, is a dangerous greenhouse gas but, at the same time, an almost indispensable fuel. Now, however, the industry has started to look for alternative energy sources to overcome the health risks that a gas-fired plant can entail in the event of an unforeseen malfunction and the excessive costs associated with its maintenance.

Zelle-engineering, a young company based in Trebaseleghe (Padua, Italy) and specialising in the design and production of forged wheels for the high-end car and motorbike industry, chose electricity as the alternative energy source for its new coating line. Indeed, a recent factory extension

project included the construction of a new hall to accommodate the pre-treatment and coating phases of forged aluminium alloy and carbon wheels, which were previously outsourced but are now carried out directly in-house. "The decision to insource the coating operations was motivated by the need for greater control of our production process to achieve the high quality standards that the market increasingly demands," states Davide Lucaora, the production manager of Zelle-engineering.

"Building a plant from scratch requires a huge investment, but it also offers the possibility of defining its operating conditions without the limitations of existing infrastructure. We had imposed two prerequisites for this system: an all-electric power supply, to eliminate the need for gas and enable our employees to work in complete safety, and maximum flexibility, to easily switch from solvent-based to water-based liquid top coats and to add or exclude process steps according to different programmes. Tecnofirma (Monza, Italy), which has been active with an international vocation in the pre-treatment and coating fields for over seventy years, especially in the automotive sector, was able to meet all these requirements.



Zelle-engineering's wheels are forged to measure

Founded in 2008 by Davide's father, Luigi Lucaora, who channelled many years of personal experience into it, Zelle-engineering is now a benchmark in the sector, especially for companies that require a high customisation degree of modular or monoblock rims. "We started by designing and manufacturing our 6061-T6 and 6082-T6 forged aluminium modular wheels.

Modular wheels differ from monoblock ones in that the former are assembled with other components, such as channels and flanges, whereas the latter consist of a single piece," explains Davide Lucaora. "Zelle-engineering's target market includes high-end aftermarket and OEM manufacturers as well as producers of cars and motorbikes in limited editions. As such, it is characterised by very frequent trend changes. When the needs of the industry shifted towards an increasing demand for monoblock rims, which guarantee higher performance degrees thanks to their lower weight and are therefore more suitable for the sports car sector, we adapted our production by investing in new machinery to be able to manufacture both types of wheels. Today,

over 50,000 cars are equipped with our rims, which we produce in diameters ranging from 13 to 24 inches. We have also recently launched some forged aluminium wheels for motorbikes with diameters from 16 to 21 inches."

Zelle-engineering provides its customers with a complete service, from the co-design of the stylistic features to the 3D drawing and structural analysis of the rim. "The safety of the drivers of any vehicle fitted with our wheels is paramount to us and the reliability of our products is renowned," adds Lucaora. "The growing reputation of our wheels has even led some international armoured vehicle manufacturers to ask us to produce special reinforced wheels using our lightest and strongest alloys."

Turning and milling are the two processes for which this company stands out. "Our latest-generation lathes perform the shortest but most important machining step in our production flow, as this is where raw aluminium loses more than 80% of its weight. The flagship of our manufacturing process, however, is the milling phase, carried out with 3- to 5-axis milling machines with which the turned blanks



The entrance to the drying oven.

A wheel loaded onto the floor conveyor.

take on the shape and style defined by our engineering department to be transformed into wheels – ready to be coated in the recently installed state-of-the-art plant that adds the final touch of perfection to our products.”

A safe and zero-emission plant

Another aspect that makes this company stand out from the rest of the industry is its environmental vision. “When we decided to insource coating to have more control over this fundamental and delicate stage, improve our finishes’ quality, and reduce our delivery times, we knew we wanted a technology that could provide us with an effective energy alternative to the use of methane gas for plant operation. Tecnofirma’s 100% electrically powered coating line was the best-suited solution. Having eliminated the use of gas ensures we operate in a safer working environment and reduce our carbon dioxide emissions.”

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From top left clockwise:

The automatic sideshift system to transfer the parts from the overhead conveyor of the pre-treatment tunnel to the floor conveyor of the coating plant.

Two of the three booths: the one for applying powder primers (left) and the one for liquid base coats (right).

The inside of the powder application booth with WAGNER equipment.

After machining, the wheels are taken to the recently built hall accommodating the new system. The company's coating manager, Luca Zampieri, describes the standard rim coating cycle as follows: "The wheels are loaded onto the overhead conveyor that transports them along the 13-stage pre-treatment tunnel. Afterwards, they are dried at 100 °C. This is followed by a forced cooling stage in a tunnel and a natural air cooling one. An automatic sideshift system then removes the parts from the overhead conveyor's bars and loads them onto the floor conveyor that takes them to the three automatic coating booths equipped with CMA Robotics robots. One applies powder primers with thicknesses ranging from 100 to 120 microns and it is linked to a WAGNER powder centre. The second applies liquid base coats with thickness values of 15 to 18 microns and the third applies liquid clear coats with a thickness between 20 and 25 microns. "After powder application, the coating is cured in an oven at 180 °C for 40 minutes

and cooled in a ventilated tunnel for 18 minutes. This is followed by IR pre-heating and base coat application. Flash-off between the first and second coat takes place at a temperature of 30-40 °C for 24 minutes; after the application of the second coat, flash-off occurs at room temperature for 16 minutes. The last section of the line includes a curing oven for baking the liquid clear coat at 160 °C for 40 minutes and a station where both forced cooling in a ventilated tunnel and natural air cooling take place." At the end of the coating cycle, both types of wheels, i.e. modular and monoblock, are subjected to strict controls by the quality department, which tests all parts for conformity to the specified tolerances. Once a wheel has passed all tests, it is ready to be packed and shipped.

The flexibility of the new system

"Both the overhead conveyor and the floor conveyor are equipped with a total of 85 load bars and have a speed of 0.5 m/min," indicates Salvatore Caprino, sales engineer at Tecnofirma.

"The concept behind this new automated coating line is maximised flexibility for handling small batches, down to only 4 wheels, and carrying out up to 20 colour change operations per shift. The main features of this plant include an all-electric power supply and ease of handling

thanks to automation. This initially had a strong impact on the company's operators, who were accustomed to manual processes, but it is now perfectly understood and managed by all of them."

Another technical solution implemented in the pre-treatment phase is the presence of two deoxidation tanks allowing the most suitable pickling programme to be selected depending on the type of wheel. "In the case of raw rims," indicates Caprino, "the parts can be pre-treated with aggressive oxidants. In the case of diamond-finished wheels, however, this is not possible because such chemicals could damage their surfaces. Therefore, the installed software package allows the second tank to be chosen, with more suitable oxidants. The same flexibility, which is truly the strength of Zelle-engineering, also characterises coating. For example, as diamond-finished wheels require two layers of clear coat, the powder primer application robot can also apply the powder clear coat, on which the liquid clear coat is then applied in the third booth. Polished wheels, after pre-treatment, skip the primer and base coat application stages and are sent directly to the third booth for clear coat application. Finally, when treating carbon wheels, the cycle remains identical, but the oven temperatures can be lowered. In short, this plant allows treating the surfaces of all different parts in a versatile manner thanks to its user-friendly management system."

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Conclusions

“Thanks to automation,” confirms Lucaora, “we have been able to increase our production speed so that we can meet increasingly stringent specifications within shorter delivery times, thus fully responding to our customers’ requests as the bar for quality and functional performance is raised higher and higher.

Another important advantage is that can run the plant with only three operators.”

“We also greatly appreciated the speed of installation and commissioning,” emphasises Zampieri. “Installed between March and April this year, the system was already functioning at 100% by September.”

“In addition to higher plant productivity and greater control over coating quality,” concludes Lucaora, “what makes us most satisfied is the opportunity to improve the safety of the workplace and the impact of our activity on the outside environment. Even when – in 50% of cases – we use solvent-based paints to meet customer specifications, the activated carbon filtration device purifies the air before it is released into the atmosphere. We are aware that the manufacturing industry in general and our sector in particular still have a long way to go for the complete decarbonisation of production processes, but this plant represents an important step forward for us. It is a demonstration that it is possible to fulfil the commitments made at international meetings for future industrial production based on renewable sources.”



The CMA Robotics robots’ control units outside the booths.

The inside of the top coat application booth with Edrizzi filters.