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**Opening photo:** In 1972, Berti Macchine Agricole (Caldiero, Verona, Italy) decided to specialise in the production of mulchers, whose range now includes 500 models.



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# Berti Macchine Agricole. An Innovative Industrial Solution for the Coating Process of Its New Production Site.

Alessia Venturi **ipcm®**

The switch from manual-only operations to an automated, robotised, and digitised process; total traceability of the operating process; data collection; and diagnostics for preventive maintenance: these were the requirements

of a well-established Italian manufacturer of agricultural machinery for the redesign of its coating process by a group of plant engineering firms. Some of the main players in the sector accepted the challenge: by effectively collaborating

in all design and development phases, they created one of the most advanced finishing systems ever installed in the agricultural machinery sector. This new coating plant started in 2018 by Berti Macchine Agricole and born from

the collaboration among Savim, Futura Convogliatori Aerei, Gaiotto Automation, and Verind is compact, modern, extremely functional, and Industry 4.0-oriented.

### The story of a company and a family

Berti Macchine Agricole was established by Livio Berti in Caldiero (Verona) in the early 1920s, as an artisan company in the field of agricultural implements. In 1972, the Berti family decided to specialise in the production of mulchers (ref. Opening photo), developing them at the technological level for over thirty years. More than thirty years have passed since the creation of the first vineyard and orchard mulcher. One of the company's main objectives has always been to build innovative machines specially designed for the professional maintenance and reclaim of urban, agricultural, and forest green spaces. Berti now offers a range of 500 products for all types of cultivation and ground conditions, applicable to any tractor or excavator. Its complete range of robust and high-performance equipment is divided into two product lines intended for two well-defined market segments. The "agricultural line" includes vineyard and orchard mulchers, mowers, in-line mulchers, hedge mowers, and forestry mulchers (with an installed power range from 15 to 300 HP). The "professional line", on the other hand, includes different earthmoving devices intended for maintenance and forestation operations, which are suitable for every kind of excavator (with an operating weight between 1.5 and 35 tonnes) and skid steer.

### The production flow

"Our machining and welding operations are entrusted to a few contractors that work almost exclusively for Berti," says Sales Manager Filippo Berti (Fig. 1). "Until a few years ago, our work was seasonal: production

reversed, our production is now steadier, as is the workflow with our contractors." "We order all the productive material according to our technical office's instructions and all workshops operate with our know-how," says Filippo Berti. "Our production flow is order-based: our main issue are delivery times, because the fact that the European dealers operate with very little stock does not match well with the requests for 20-day deliveries now typical of this market. Indeed, there is now a trend towards a just-in-time production. That is why in 2015 we decided to start a corporate restructuring project involving our productive structure, and especially our downstream processes: assembly, coating, and storage. This investment and restructuring plan was mainly motivated by our will to switch from an order-based to a continuous-flow production. We currently have six assembly lines, which will become nine in January and twelve at the end of 2019, of which five will be devoted to continuous

production and seven to special machines." "After assembly, we also focussed on our coating phase. We already had a recently bought plant installed in a building specifically devoted to this operation. However, it was a static system performing a manual application process and using solvent-based paints. Luckily, the corporate growth of

the last few years enabled us to invest in a new, technologically advanced automatic system and, at the same time, to switch to water-based coatings," explains Filippo Berti.

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**Figure 1: From left to right: Filippo Berti, Berti Macchine Agricole's owner, Maria Grazia Signorini, Finance Manager and Francesco Attuati, Purchase Manager.**

peaks were concentrated from February to July, while the last months of the year were dedicated to the preparation of the new season. By differentiating our target markets and also working overseas where seasons are





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**Figure 2: A bird's eye view of the new coating plant supplied by Savim (Arbizzano, Verona).**

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**Figure 3: A detail of the plant.**

"Using two-component water-soluble coatings was a business choice unrelated to any regional regulation," says Purchase Manager Francesco Attuati. "We assessed that the market is gradually abandoning conventional solvent-based products in favour of water-based systems with the same performance. Moreover, we are located in an urban environment: over the years, the town of Caldiero has practically developed around our plant. Therefore, switching to water-based coatings seemed the most natural choice for us, although there remains a small part of our production requiring solvent-based paints. Finally, in our new production area, we also added an automatic warehouse to favour the switch from an order-based to a continuous-flow production."

### The origin of the new coating plant 4.0

Since it used to perform only a manual painting process, Berti did not have any knowledge of coating systems. "In order to design the new plant (**Fig. 2 and 3**) and, above all, understand how our automation, productivity, and surface quality needs could be met, we did some technical research and spoke with people who had already installed a coating system," says Filippo Berti. "We thus came into contact

with Savim (Arbizzano, Verona), which then recommended all other technological partners for the handling, automation, and application aspects, i.e. Futura Convogliatori Aerei, Gaiotto Automation, and Verind. Under the coordination of Savim, we created a relationship of mutual esteem with all of them."

"The plant designed by Savim was undoubtedly the most suitable to our production needs

and automation requirements," says Attuati. "Inver, our supplier of water-based coatings, also greatly supported us in the design phase. Understanding our coating requirements was crucial to design an optimal application system. In any case, the starting point for us was our will to create a new production structure that was a linear, streamlined, efficient, automatic, and completely traceable at all times."

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**Figure 4: A component at the entrance of the pre-treatment booth.**

## Characteristics of the coating line

The system installed by Savim is completely Industry 4.0-oriented. By interfacing with the automation and application systems, the management software package collects and checks all operating parameters, applied thicknesses, and consumption data. The project also included a thorough study of ergonomics, flexibility, and modularity, so that the new line meets every current and long-term future production need.

The maximum capacity of the plant is 4 m in length; however, two manual booths (primer and enamel) have been devoted to machines with larger dimensions, accounting for 15% of the total production. The plant management is based on barcodes.

The chemical pre-treatment is performed with a 3-stage process (Fig. 4 and 5) followed by an intermediate blow off and masking station. Berti coats fully assembled machines and, therefore, all delicate components must be protected. The coating application station features two dry booths with a floor filtration system, a robotised and a manual one, for both the primer and enamel application.

Savim chose to integrate these automatic booths with two manual ones (Fig. 6) to coat oversized workpieces, but also to perform accurate post-retouching operations on parts where particular masks may hinder uniform coverage by the robots and to treat the components that still require a solvent-based coating, accounting for 15% of production. The robots are equipped with electrostatic guns, whereas the manual booths perform a conventional application operation. The application process includes a flash-off phase between the primer and enamel application stages and a final curing stage in a direct fired furnace (Fig. 7).



**Figure 5: The 3-stage chemical pre-treatment process.**

"We opted for the use of a water-based liquid system with an application and automation system that would allow us to industrialise and automate a process that used to be completely manual, little controllable, and hardly standardisable," states Francesco Attuati. "The goal was to improve the process, increase quality, decrease consumption and waste, and above all digitise operations as much as possible."

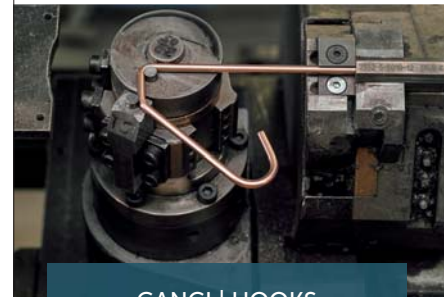
The products applied by Berti are the

INVERPUR semi-matte two-component anti-corrosion primer based on hydro-soluble acrylic resins and the INVERPUR/X SM 2K two-component water-soluble enamel based on acrylic resins, both in the company's distinctive orange colour. They are supplied by Inver, a brand of the Sherwin-Williams Group. The primer forms a film with good salt spray, chemical, and water resistance characteristics. It reduces the enamel brilliance very little and it is a suitable basecoat for iron, aluminium, and cataphoresis products, as it has excellent adhesion

and good corrosion protection properties.

The two-component enamel forms a hard and elastic film with excellent weathering resistance characteristics and it is suitable for high quality finishes on metal surfaces of various kinds, such as agricultural and earth movement machinery, machine tools, and industrial vehicles. It is applied with a viscosity (D4/25 °C) of 50-70" and with a final dry thickness lower than 50-60 µm.

"For the design of the paint application and feeding system, we chose to rely on Verind, belonging to the Dürr Group, because its equipment range was the closest to our needs for 4.0-orientedness," states Filippo Berti. "In order to develop the best application system, Verind had a preliminary



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Figure 6: One of the two manual booths.

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meeting with Inver to share a few technological choices. In fact, our two products could be applied with both the mixed air and low pressure technology: our coating quality depended on this choice.”

“Our choice fell on an airless air assisted application for the primer, in order to achieve the right thicknesses and application speed, and for a low pressure application for the enamel, in order to ensure maximum aesthetic quality,” explains Verind Area Sales Manager Giovanni Benevelli (Fig. 8). “Therefore, we developed a flexible and modular system that combines an electrostatic application process with an automatic system for the dosing and mixing of 2K

coatings through fibre-optic flow metres (Fig. 9). The coating management unit is equipped with three groups of lifts for the 200 kg-drums used for the storage of paints, level sensors, and Dürr circulation pumps for the primer and enamel.

The remote coating management unit (Fig. 10) is located about 50 m of pipes away from the booths. Specific loading stations feed directly the process tanks of both the manual application stations and the insulated stations that contain the electrostatically charged pumping systems.”

“The application equipment of the primer (Fig. 11) and enamel booths are symmetrical,” says Benevelli.

“Each booth features an EcoDose 2K electronic dosing system. The automatic stations’ systems are equipped with a remote station, fibre-optic volumetric



Figure 7: The curing stage in the direct fired furnace.