

Masters in casting (and rolling)

It's been some years since Continuus Properzi introduced any major new equipment for the lead battery industry but it has just introduced a new line for casting and rolling lead strip. With some uncertainties on the future of lead (in Europe at least) why now? Technical editor Mike McDonagh and Gerry Woolf went to Milan to find out.

Continuus Properzi is one of those names in the battery industry that has something of a pedigree— for those in the know. Back in the 1980s, the company collaborated with Magneti Marelli to build the first expanded lead metal strip lines for automotive battery grids.

The company worked with the Fiat group to refine the equipment, until Exide took over and bought high production lines in the early 1990s.

The rest is history and today expanded metal strip production is ubiquitous in the lead-acid battery industry.

But that's not how the company got started— in batteries or even in lead.

The company's heritage goes back to 1947 when Ilario Properzi

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Continuus Properzi

The new casting and rolling line.

established the business, based on skills around casting and rolling a number of metals, including aluminium, copper, zinc and of course lead.

Italy was recovering from World War II and these basic manufacturing skills were in short supply. The first

commercial product in the lead field from Properzi was shot—the company had perfected a perfectly rounded version which was more effective. Today the business is still family owned and run. Giulio Properzi, Ilario's son is at the helm, aided by his daughter, Chiara. With 170 employees and a turnover averaging EUR50 million (\$61.3m) perhaps only one tenth of the business comes from the battery world.

We could say that the company has been a little “quiet” in introducing new products into the battery sector in recent years. But the launch of a wide format continuous casting and rolling strip mill is a substantial innovation for the company and for purchasers, a significant investment. With the exemption



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of lead-acid batteries in the European End of Life Vehicle directive (EU Directive 2000/53/EC Annex II) extended by just three years, creating some uncertainty on the future of lead-acid batteries, why now? The answer is pretty simple— the increasing uptake of punched-grid technology— the low cost superior alternative component for deep-cycle battery applications and UPS. The Properzi design allows the production of a full width 350mm strip which facilitates simultaneous, double panel punching.

Producing such a wide strip is beset with difficulties. Firstly, you have to deliver sufficient force to get reduction of the strip and Properzi achieve a 300% reduction with four-stage rolling— the final strip thickness is between 0.6 and 1mm. The other challenge is maintaining a flat profile across the strip, which has all kinds of knock-ons from paste weight control to flat pack insertion. Maintaining

the thickness control is another tough call, but Properzi have achieved this by having all rolling stands adjustable and independent.

These are just the headline advantages. To work out what's really clever about this new line needs a detailed overview from end to end. Let's start with the furnaces— a three-stage process. The first is to melt the lead ingots and the scrap from the punching station. And then bringing them up to temperature. The second stage is to make adjustments to the alloy constituents in order to ensure that this is of the correct specification before the casting and rolling process. The third furnace is to ensure that feed stock composition and temperature are stable. There's a sophisticated feedback system to ensure that there is a continuous, uniform process.

Feeding the molten alloy onto the casting wheel has to be accurately controlled to within a very small tolerance.

This is achieved through a two-stage tundish system— effectively a reservoir to guarantee the feed ladle has a precise level of molten lead alloy. This level is used to deliver a continuous and accurate volume of molten lead to the casting wheel and this ensures the cast strip is consistent. The level is adjusted by a lever, controlled by a threaded balance weight, which regulates the flow via the ladle. Any surface dross is removed with a fixed blade reaching just below the surface, which cleans the molten alloy as it flows underneath it during the pouring stage.

The casting wheel consists of a rotating drum consisting of a forged steel ring 80mm thick. Heat is removed via a water cooling tower resulting in a rapidly solidifying alloy. A recirculating steel belt is in contact with the alloy. A precise distance ensured by contact of the belt surface with the outer edge of the cooling wheel. This design ensures there is no leakage of molten alloy and also achieves a precise cross-section of the cast strip.

The chilled strip is scraped off the wheel and transferred to rollers, where there is a buffering station that raises or lowers the strip to prevent over or under tension when transferred between process stations. The next stage is a cutting step that has the dual role of cutting off the misshapen leading edge of the strip produced on start-up of the process. It also allows cutting out sections in case of damage to the cast strip before it goes through the rollers.

Giulio and Chiara Properzi— still a family business.



The pressure rolling is the critical part of the process that determines the quality of the grid and ultimately the performance of the battery being manufactured. The amount of strip reduction through the rolls will determine the crystal structure and the age hardening properties of the finished strip. Incorrect deformation in this process can result in a corrosion sensitive grain structure, depending on the alloy composition, leading to early battery failure.

Another potential weakness at this stage is the centre-to-edge thickness distribution. Properzi's design avoids these problems through decades of working with customers to obtain the ideal process parameters giving the best grain structure to minimise corrosion.

Our guide and mentor in Properzi, Ing Gabriele Muscamera summed it up this way: "When a customer places an order with us we bring a 70-year history of collaboration combined with a technical and engineering team of experts in every aspect of machine manufacture and operation. This is more than customer focus, it is the DNA of Properzi."

Thickness variation, which can lead to pasting problems caused by flexing of the reduction rollers, is eliminated by Properzi's unique reduction drives and pressure control. Pressure control is achieved by a unique automated mechanical system using a wedge, which varies the pressure on the total roll group. As the strip passes through this stage, there is a

sensor to detect imperfections in the shape. These "cobble or ripples", once detected, are removed by cropping the section of strip where they occur, which is then returned to the first melting furnace.

The next stage is to remove the rolling lubricant through a drying tunnel that evaporates the volatile organics. The

strip's edges are trimmed to remove splits and the resulting deformed structure. This also enables the required dimensions as specified by the customer to be obtained.

The final stage is coiling the finished products. Size and weight is not inconsiderable. Depending on throughput, the coils can weigh up to five tonnes

The two-stage tundish ensures the correct volume of molten lead reaches the casting wheel.



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although the standard weight is a 2-3 tonne coil, 1.15 metres high with 400mm internal diameter.

This final stage can accommodate two coils, to enable the process to function continuously. To facilitate this there is an automatic cutting and guiding system that both controls and ensures a completely automatic operation.

The strip is cut after the desired length has been wound around the mandrel. The automatic feed has two guides and the guide that feeds the second mandrel has already been put into a position to redirect the leading edge of the cut strip before the first coil is finished.

After the strip is cut, the production continuity is maintained as the severed leading edge is directed to the second mandrel. At this point the mandrel guides are closed to a position which ensures contact of the strip with the rotating empty mandrel.

The friction created by this rotation eventually pulls the

strip into the coiling process without distortion or damage. This is then repeated for every coil during a production run. The weight of the coil is directly proportional to its width. As a guide 320 mm strip width gives a three tonne coil.

It is not difficult to work out that Properzi is very much a bespoke manufacturer of equipment in this field and delivery of such machinery is dependent on an experienced and highly-trained workforce.

Properzi employees are long stayers... the head of engineering has been with the company since the very early 1980s and will probably never leave jokes Giulio Properzi. Apprentice recruitment and on-going personal development are key components of the Properzi philosophy— as is a commitment to keeping most of the manufacturing in-house.

The company sports a range of CNC machines to fabricate the most complex components and there is a subsidiary electronics business to build, from the

ground up, the unique control systems.

Giulio is clearly a man with vision, justifiably proud of his family legacy, he is continuing the family tradition of engineering innovation and investment in people and training. He firmly believes that they are the best company in the market. His reasons are centred around the concept at the very core of the business model: you can only be the best if your people are the best. This fundamental concept is easy to claim but not so easy to deliver.

The first precept of their service is that of total design philosophy. This can only be achieved by ensuring a total in-house skills base. To realise this, engineers and technical staff are carefully selected and trained to ensure that the full range and level of expertise necessary to facilitate the company's policy, are in place.

According to Giulio Properzi: "Growth of company like ours is difficult as we are in niche markets. It is achieved by expanding the expertise of our staff. As they grow, the company can grow."

This philosophy is cleverly turned into a business model that avoids competition with giant multinationals. Properzi manufacture almost all of their components in-house in order to guarantee their function and quality across all applications. It is this dedicated service which ultimately makes their customers, including battery manufacturers, more competitive in these increasingly difficult markets. +

Powerful motors ensure the correct reduction to the strip is achieved.

