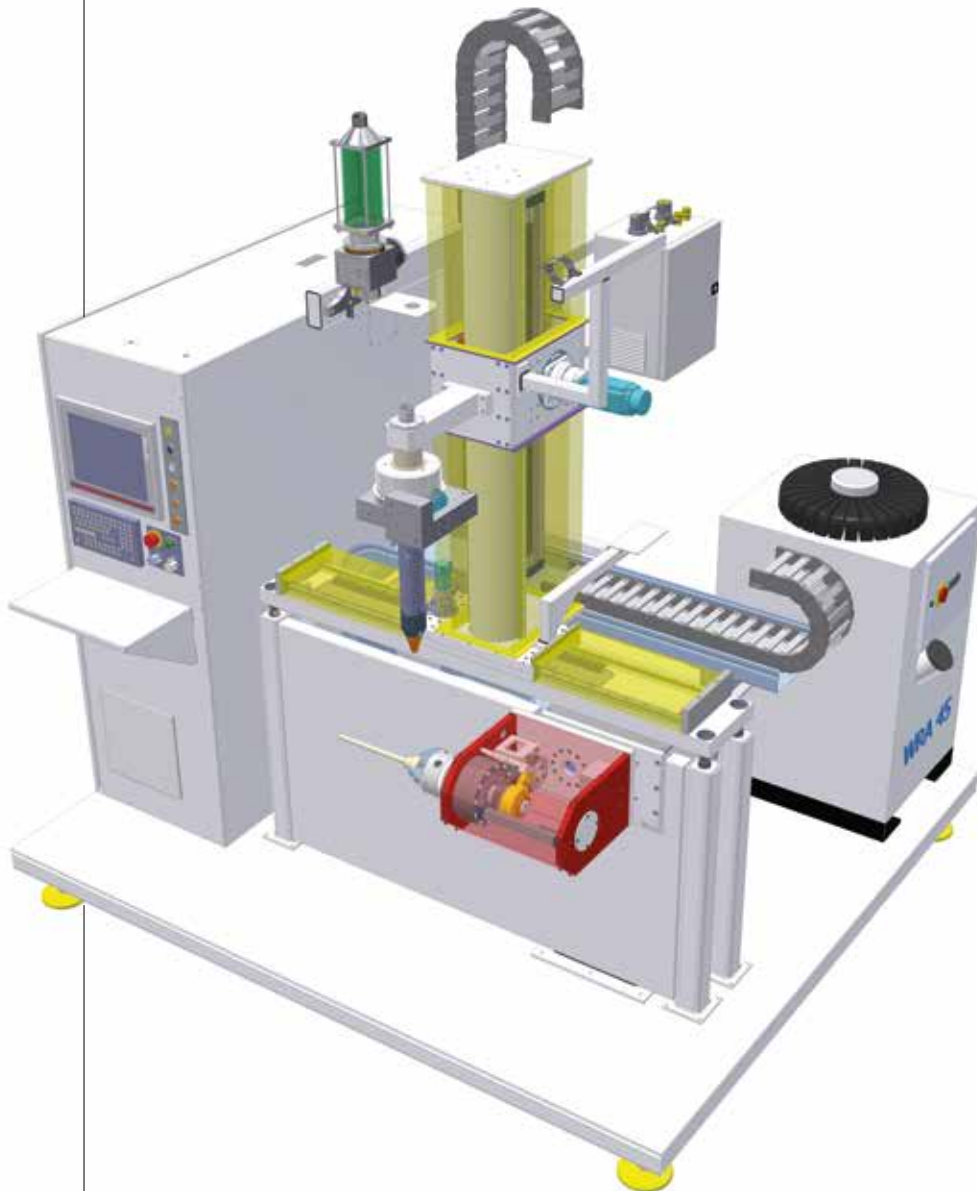


Advanced plunger coating achieved with **COMMERSALD IMPIANTI** technology



Technological research by Commersald Impianti concerning machines and equipment for P.T.A. (Plasma Transferred Arc) hard-facing glass moulds continue to produce innovation. Until now, the use of nickel alloys has had a fundamental role in the coating of plungers for the glass sector - filling the gap between mould wear, neck-rings, bottom and plunger. Here the term 'nickel' is applied to describe the series of nickel-chrome-boron-silicon alloys (Ni, Cr, B, Si) which have a relatively low melting temperature of between 1050°C and 1150°C. If one considers that cast iron or steel have melting temperatures of around 1400-1450°C, it's easy to see how such alloys can be easily coated and recast without causing the melting of the base material. In fact, the difference in melting temperature between nickel-based alloys and base material is around 250°C, allowing the operator to perform the recasting of the nickel-based alloy in complete safety. Remelting is necessary as nickel-based alloys are mainly coated using two methods: oxyacetylene flame and HVOF technology.

Demonstrating how nickel and cobalt alloy coatings for plungers enhance both durability and efficiency in moulds, COMMERSALD IMPIANTI's research into Plasma Transferred Arc technology continues to advance glass mould production. Indeed the company's PTA machines improve coating precision and reduce waste, significantly extending plunger life – all to the benefit of glassmakers and mould manufacturers alike.

During these two methods, the nickel-based powders are fused and impacted against the base metal, creating a series of more or less porous layers (depending on the speed at which the particles impact the target surface) and must then be recast to remove porosity. Remelting can take place with different methods, in some cases by means of an induction system to bring the deposited layers close to the melting temperature, but the 'final touch' must be carried out by hand by experienced staff.

USING COBALT COATING FOR PLUNGERS AND OTHER MOULD ACCESSORIES

Plungers are an important part of the moulds production process. PTA machines use an arc process to melt and deposit the powder material onto moulds. However, in the case of plungers, which are long and thin, the welded material tends to slide downwards. Another important fact to consider is that the coating of plungers is mostly carried out manually as opposed to automatically. Here's where one needs to factor in operator skills, given that s/he must



carry out further work to weld the powders onto the surface 'by hand'. These plungers were then turned and processed to reach the smoothness required. Smaller plungers such as Blow Blow, were, until recently, made of Carbon steel or cast iron, then coated by hand (sprayed and then welded) by experienced and skilled workers. These operations had to result in a surface as compact as possible and

then smoothed. Some clients showed that after 92 hours of work, the nickel in the coating of small-sized plungers started to 'lift away' from the surface of the metal. This meant that when the plunger came out of the bottle being produced (with glass at very high temperatures), it dragged some of the molten glass with it because the surface of the plunger was no longer smooth and compact. Thereafter, glassmakers started to request higher



hardness, even 40, 50 or 60 Rockwell instead of 30. This extreme hardness meant that after 92 or 100 hours of work the plungers needed to be completely replaced, with relative production downtimes to change the parts. Depending on the type of glass used, plungers work at high temperatures: 1200, 720, 650 or even 580°C. What's more, processing alloys with hardness of 60 Rockwell is extremely difficult, and even the strongest metals soften when working at high temperatures, such as nickel-chrome-boron-silicon alloys, which are hard at environmental temperatures. The only alloy that does not soften at high temperatures is a cobalt alloy. The term Cobalt defines an alloy with the following chemical composition: Cobalt-Chromium-Tungsten, or Cobalt-Chromium-Molybdenum, in some cases, with the best performing alloys, namely Cobalt-Chromium-Tungsten-Molybdenum-Silicon-Carbon-Boron. The main feature is the persistence of hardness when hot. In fact, cobalt alloys with a hardness of 40 Rockwell at environmental temperature, also maintain this level of

hardness at high temperatures. This means that a plunger that is not so hard at environmental temperature (but easy to process) maintains this same hardness when working at extremely high temperatures. An important advantage for both mould and accessory manufacturers, as well as for glassmakers. The conclusion reached was that instead of coating using nickel-chrome-boron-silicon alloys, cobalt-based alloys should be used for plungers. But there was a problem which involved the fact that carbon steel and cast iron have a different melting temperature, which is about 1400-1450°C just like the cobalt alloys. This means that these alloys can be sprayed using the same blowpipe or by means of HVOF, but when these are re-melted, the part below the coating melts, so these alloys can be deposited using traditional methods, but not re-melted. The next step was then to look for another method of coating, and this is exactly what was done.

THE USE OF PTA

At this time, Commersald Impianti started using PTA, a special method of hard-facing, also for the smallest diameters, creating new equipment that works at very high rotating speeds with extremely efficient numerical control, and practically all new accessories, starting right from the nozzle. Using PTA to melt the coating onto the plungers with cobalt alloys, there is no need to re-melt, as PTA welds the material onto the surface at 18,000°C. The only part that is melted is the very external surface. When the plungers were tested in glassworks coated using this new method, their working life was discov-

ered to be three times longer than other plungers (more than 300 hours, sometimes up to 600 hours depending on the type of glass being used, instead of 90 hours as previously). Moreover, there is another important advantage. With the traditional HVOF method of coating, a large part of the material (about 70 percent) to be coated is dispersed in the air. For example, a small-sized plunger needs 90 to 100 or even 120 grams of powder. With PTA, three plungers can be coated with the same amount of powder, as the process is completely automatic and numerically controlled, without human intervention. This also means that the machine can process up to 52 plungers in the same time it takes to coat a single plunger manually, without operator intervention for at least three hours, with the exact same coating results.

TESTING THE NEW PLUNGERS DIRECTLY AT THE GLASSWORKS

Testing was carried out directly at glassworks, i.e. at the end users of these accessories. During these tests, with cobalt-coated plungers working alongside nickel-coated plungers, the results were clear to see, especially concerning the duration of the plungers, but also the quality of the glass bottles produced. Glassworks then started to request cobalt-coated plungers from mould manufacturers, who needed Commersald Impianti's PTA machine to coat the plungers.

NEW MACHINES

Commersald Impianti's machines needed to be specifically designed to process these plungers. When speak-



ing to mould manufacturers, many reported that they manufacture plungers only for the first part of the month. Consequently they wanted a machine that could also process neckrings and bottom plates, etc. However, for the first machines sold (starting from Glasstec 2018), customers wanted a machine that processed neckrings too whereas they processed only plungers during the first year, over 18,000. Thanks to these new machines, companies have been able to significantly increase their plunger workload; first with nickel coating, then with cobalt-coated plungers. These machines can also coat with nickel, with the advantage of coating a higher number of plungers. The same machine can be easily adapted to work with neckrings and other accessories simply by changing the tray containing the items to be coated, the gripper to pick the items up and changing the programme of the machine. To date, however, solely plungers are coated with cobalt, due to the fact that other accessories are made of cast iron or bronze, which can't be coated with cobalt. With these new machines, Commersald Impianti has indirectly created a new type of demand

in the market. PTA machines are really simple to use, as the operator needs to stay near the machine for the first 15 minutes only, just to set up the programme of the process to be carried out. The important characteristic of this machine is its standard format, which is able to process 52 items, working without operator intervention for almost three hours. When bottles are created with an IS machine, for example, temperature management is fundamental. In fact, the shorter the time it takes to create the bottle, changing the glass from liquid state to solid state, the better the results will be. On the other hand, if the glass temperature is low and the glass is too dense, it will damage the plunger. When IS machinery users replaced some of the plungers used with cobalt-coated plungers, they saw that these plungers worked at 100°C lower temperatures because the heat exchange created by the air flow was extremely efficient. This means that cobalt-coated plungers cool down faster. As such, they exhibit an elevated performance level and will manufacture more bottles as well. A lot of glass-making groups have already informed their mould manufacturers that they prefer to

have cobalt-coated plungers, which is why mould manufacturers bought Commersald Impianti's machines (also thanks to the benefit of automatic working), with loading and unloading included. A further important characteristic of these machines is that both coating and all handling operations (including preheating operations if required) can be programmed by single numerical control.

MACHINE TYPES

Here Commersald Impianti has created three machine types:

- Standard Version: Carries out automatic coating of plungers;
- Top Version: Coats neckrings and accessories and includes a 12 kW induction pre-heater;
- Manual Version: Requires automatic loading and unloading of plungers and allows the possibility of short production runs (not just for 52 items, but also for smaller batches such as 10 to 15 items for more modest-sized mould manufacturers).

This is an important example of how technological developments and human insights that lead to these developments are both essential to boosting the quality of final products - all while improving the working conditions of operators as well. ■

COMMERSALD IMPIANTI

**COMMERSALD
IMPIANTI Srl**

Via Antonio Labriola, 42
41123 - Modena - MO - ITALY
Tel.: +39-059-822374
E-mail: impianti@commersald.com
www.commersald.com