Improved productivity and energy consumption in Press Hardening processes using Mechanical ServoPress Technology

In order to meet the current requirements of the automotive industry, a new step has been taken in press hardening lines that not only improves the productivity of the line but also improves energy efficiency in comparison with state-of-the-art production lines.

Mechanical servo presses and high speed transfer systems are the two types of technology that have been applied to the press hardening process to create a new manufacturing model.

Reduced cycle time is achieved due to higher speeds of the servo press compared to traditional hydraulic press. Furthermore, servo control of both the press and part transfer system allows optimum synchronization of both components with a maximum overlap of movements, thereby reducing time-wasting.

Current needs in Press Hardening lines

Early stages in PHS

During the early years, when press hardening technology was being developed, the main goal was to find a suitably reliable process that could satisfy the needs of car designers in terms of the characteristics of the produced part.

At this point, efforts focused on developing suitable steel alloys, coatings, thermal processes, and even the stamping process itself that would be used on the hot metal sheet.

Once the process was tested and proven, car designers started to include these types of parts in the development of new platforms. Although it grew slowly, this process started to become essential and forced parts suppliers to increase their capabilities.

At this early stage, the first generation of low production lines usually had a cycle time of up to 25 s for one or two parts per cycle.

If the bottleneck for mass manufacturing of hot pressed parts was considered the part cooling in the die, this situation has dramatically changed in the last few years. The development of new die designs and cooling strategies, and the presence in the market of steel alloys with high-conductivity (for example Rovalma HTCS 150), specifically designed for the press hardening process, has reduced the required cooling time, thereby changing the overall design of the manufacturing installation.

What is currently required by users of new press hardening lines?

- Firstly, continuous reductions in the cycle time. This is related to the performance of the press and part transfer system.
- Energy efficiency. It is important to address the environmental and energy costs of an installation.
- Line reliability. Do not include overly sophisticated devices that complicate both the operation and maintenance of the installation.

2nd generation press hardening lines

Reducing the cooling time to between 6 and 9 seconds opened a great opportunity for the mass production of press hardened parts on a competitive level. It reduced the cost per part of the manufacture process, making this technology more attractive for an increasing number of areas in the BIW.

At the same time, manufacturers of these type of lines have been developing different configurations and establishing different standardized solutions.

Part transfer, originally performed by robots, has been replaced in most cases by different types of dedicated feeder systems: telescopic, non-telescopic, twin transfer mode system, etc.

The roller hearth furnace has become the standard system used. Although other strategies have been tried, a reliable alternative for mass production lines has not yet been found.

High speed hydraulic presses of between 10,000 and 12,000KN are normally used to handle the standard range of parts.
3rd generation line configuration

Servo Mechanical press in PHS

Now is the right time to establish a new press system model for this type of line.

Although hydraulic presses have improved their performance in terms of speed and control, due to the use of servo-valves and high capacity hydraulic systems, they are still a long way from achieving the characteristics of mechanical presses.

Obviously traditional mechanical presses have not been suitable for use in the press hardening process as it requires the press to stop at Bottom Dead Centre (BDC) to enable part quenching.

On the other hand, there has recently been a great revolution in mechanical press stamping due to the increasing use of direct servomotors, as this system can be used to directly control the slide position. Theoretically, mechanically-operated servo presses meet the requirements for stopping at BDC, although some specific alterations were necessary.

Bushing and lubrication of the mechanical design

In order to address the fact that the press needed to stop at BDC and then restart, it was necessary to redesign the lubrication system (patented by Fagor Arrasate) and mechanically resize the contact surfaces.

The redesign also included a rapid Force Releasing System (pat. pending), that reduces the total force just before restarting the movement of the press.

This system compensates for the pernicious effects of starting and restarting the press under nominal tonnage conditions in combination with the mechanical redesign mentioned above.
Servo motor performance under static load

The hot stamping mechanical servo-press requires special working conditions from the servo motor that are not used in cold stamping. The motor must be under torque conditions but not in movement. This situation has been successfully tested under real load conditions. Although initially abnormal consumption by the motor was detected, suitable tuning of the servo motor control was achieved and as a result no significant electricity consumption was seen during this part of the process.

Kinetic Buffer

As in many other installations that use mechanical servo presses, press hardening installations take advantage of buffer systems to reduce instantaneous energy consumption by the servo motor during the stamping process. A join development with Fanuc has resulted in the GOM 112N0801/SO, which has already been tested in an existing mechanical servo press. The test results showed a significant decrease in network energy peaks. Although it can be compared to using an accumulator system in a hydraulic press, the faster reaction time demonstrated by the test results shows that this energy saving system is more efficient.

De-stacking system

In contrast to multi-robot de-stacking systems, dedicated feeding systems create a perfect balance between cycle time and the use of a straightforward system.
A three-axis linear feeder, supplied by two high capacity blank loading slides, is the best combination for faster installations.

**Press loading-unloading**

The loading-unloading system installed in these next generation lines must equal the level required by the press. “Transfer mode” has proven to be the best option for reducing the cycle time and achieving the shortest cycle times possible.

For press hardening, a specific system must be used that differs from the traditional mono rail bars used in cold stamping installations. Therefore four three-axis telescopic units are installed (2+2) to allow maximum freedom of movement and the independent loading and unloading of parts.

**Electronic System integration**

The success of the PHS does not only depend on the performance of each of the components of the line. Perfect synchronization, resulting in the highest levels of productivity, also relies on the electronic configuration.

The line is not just a series of components; through the use of a centralized line control it becomes reliable and efficient equipment.

Equipped with a centralized Line PLC, including press, destacker and press loading/unloading is operated by the same control; compatible electronic control equipment is also used in the different units, guaranteeing a reliable performance and straightforward maintenance.

**Results and advantages of the 3rd generation PHS**

As described above, a mechanical servopress is the core component of new, 3rd generation installations. Combined with the correct selection of other line components it can provide:

- Increased productivity; due to the increased speed of the mechanical press and optimum synchronization with loading and unloading by the linear feeder.
- Energy efficiency; servo press technology with a kinetic buffer improves the results of existing hydraulic presses.
- Overall reliability; tested mechanical servo press system and dedicated linear robots for optimum part quality and line performance.