Exploring the 3rd International Conference on Hot Stamping Technology, Part II

New heating and forming equipment

BY EREN BILLUR AND TAYLAN ALTAN

Editor's Note: This article is Part II of a two-part series summarizing the advances discussed at the 3rd International Conference on Hot Stamping Technology in Kassel, Germany. Part I, which appeared in the November/December 2011 issue, discussed new applications. A three-part article providing an overview of this growing technology appeared in STAMPING Journal® *from December 2006 to February 2007, and FE simulation of the process was discussed in the March/April 2011 issue.*

Heating Systems and Furnaces

The hot-stamping process begins with heating the blank over its austenitizing temperature (about 1,750 degrees F/950 degrees C for 22 MnB5 steel). The most commonly used method to heat the material is a gas or electric roller hearth furnace, but the furnace's size can be a drawback.

The length of the furnace is a function of the heating time, the cycle time, and the batch length[1] (see **Figure 1**). A roller hearth furnace can be longer than 160 ft. (about 50 m), depending on the batch length and the cycle time. In addition, the furnace length increases as the cycle time decreases.

Several new furnaces have been introduced to save space and conserve energy. Some of these new furnaces also can tailor the austenitizing process—for example, keeping some portions of the blank in ferritic/pearlitic phase—to control the final properties of the workpiece.

One new design is a double-decker configuration, which theoretically reduces the space requirement by half. In a particular case described by Lehmann, the double-decker style reduced furnace length from 187 ft. to 111.5 ft. (57 m to 34 m), including space required for a material handling system.[2]

Ebner Furnaces in Austria has introduced a double-decker furnace line that includes independent natural gas and electric heating systems. It provides two heating modes (see **Figure 2**):

1. **Rapid heating** is achieved with a gas-fired furnace. The initial zones are heated to 1,920 degrees F (1,050 degrees C), which is higher than the austenitizing temperature of 1,750 degrees F (950 degrees C). Rapid heating is achieved at the initial section, and electric heating is used later for more uniform temperature distribution.

2. **Tailored heating** is possible for up to five different temperature zones. The furnace is heated by gas in the first section up to about 1,380 degrees F (750 degrees C). The second section has electric heating and independently controlled zones. Some portions of the blank can be kept at about 1,340 degrees F (725 degrees C) to ensure that they are not austenitized. The rest of the blank can be heated by local electric heaters up to about 1,750 degrees F (950 degrees C).[3]

Another configuration, the multichamber furnace, reduces the space requirement and improves temperature control. Each blank is placed in a chamber and heated for a predefined time. The number of chambers depends on the cycle time and heating time.

Three robots are used. The first one takes the blank from the stack and puts it on a second robot, which takes the blank and puts it in one of the furnaces. The third robot picks up the heated blank and puts it in the press.[4]

Presses

In hot-stamping applications, a fast forming stroke is followed by a long quenching (dwell) cycle. A conventional hydraulic press can be used for hot-stamping operations, but two relatively new press technologies have been proposed for these applications: a flywheel-driven hydraulic press and a servo-mechanical press (see **Figure 3**).

The hydraulic press has flywheels instead of accumulators to store energy. According to the manufacturer, this design eliminates the heat

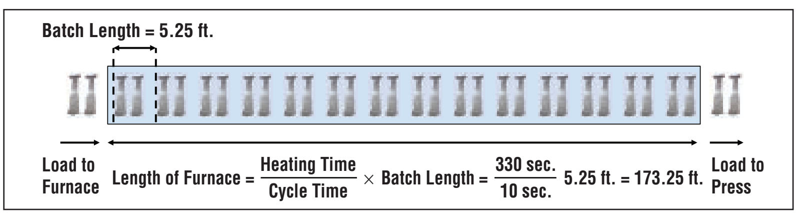

Figure 1

The length of the furnace is a function of the heating time, the cycle time, and the batch length.[1]

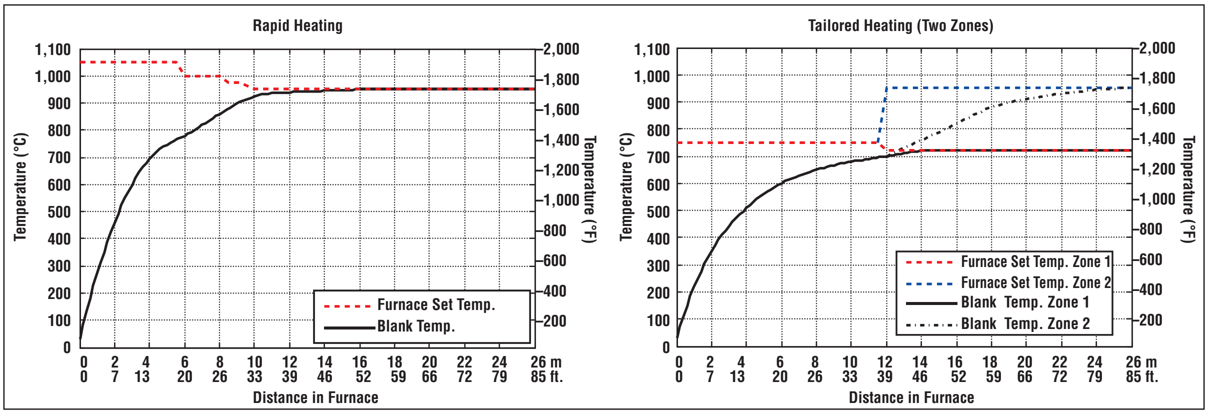

Figure 2

Ebner Furnaces' double-decker-style furnace line has independent natural gas and electric heating systems that provide two heating modes.[3]

generated in the nitrogen accumulators and selectively activates the flywheel/pump units. The press is available from 600 to 1,600 tons' nominal force and can be driven by one, two, or three flywheels, depending on the force and energy demanded. When the press requires power that is higher than the input, such as during preforming and forming, the flywheel supplies the energy. When the power required is less than the input, such as during quenching, the flywheels store the excess energy.[5]

The servo-mechanical press can reduce the required power by about 30 percent. For a 600-ton press, the main motor power was reduced from 340 kW in a hydraulic press to 250 kW in a servo-mechanical press. The press has several other advantages as well:[6]

- Closing time can be reduced, which decreases cycle time and maintains workpiece temperature for improved formability.
- Energy requirements may be reduced.
- Risk of fire is eliminated.
- Press velocity can be altered for better formability, more parts per minute, and better synchronization with the material handling system.

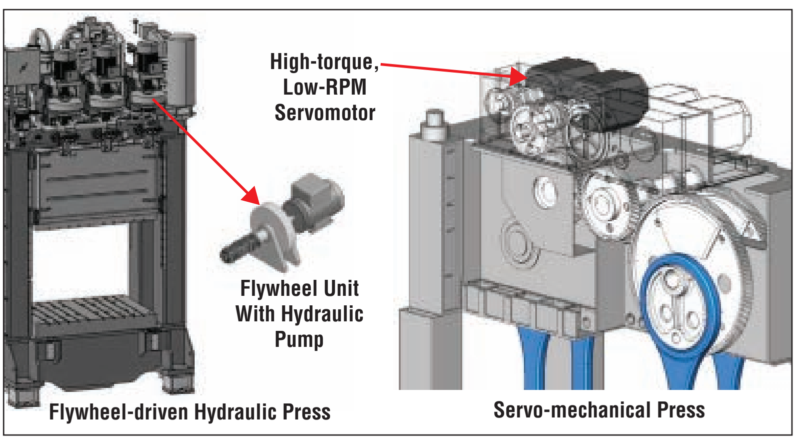

Figure 3

Two relatively new press technologies have been proposed for saving energy in hot-stamping applications.[5] Image courtesy of AIDA.

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Notes

1. K. Eriksson, "Bringing it Together," in proceedings from The AP AP&T Advanced Hot Stamping Seminar, Detroit, Sept. 15, 2010.

2. H. Lehmann, "Developments in the Field of Schwartz Heat Treatment Furnaces for Press Hardening Industry," in proceedings from 3rd International Conference on Hot Sheet Metal Forming of High-performance Steel, Kassel, Germany, July 13-17, 2011, pp. 171-179.

3. F.J. Ebner, "HotPHASE – Press Hardening Automotive Solutions by EBNER," in proceedings from 3rd International Conference on Hot Sheet Metal Forming of High-performance Steel, pp. 247-253.

4. K. Eriksson, "Press Hardening – Process Design," in proceedings from 3rd International Conference on Hot Sheet Metal Forming of High-performance Steel, pp. 263-268.

5. R. Hund, "Continuous Improvement of Hot Forming Technology," in proceedings from 3rd International Conference on Hot Sheet Metal Forming of High-performance Steel, pp. 189-200.

6. E. Gamboa, X. Agirretxe, J.M. Martin, and K. Gorostiza, "Compact Line Conception for Hot Forming Lines," in proceedings from 3rd International Conference on Hot Sheet Metal Forming of High-performance Steel, pp. 181-187.