EXECUTIVE Report

CuproBraze Proves Flexible in the Manufacture of Heat Exchangers

Furnace Configurations Available for Every Production Objective

*Cu*proBraze technology lends itself especially well to flexible manufacturing. A wide range of heat exchanger cores of different sizes and designs can be processed on the same production line. Various furnace types are available depending on the objectives of the heat exchanger manufacturer and the mix of products. Moreover, the technology can be adapted to suit the local labor markets.

These options are not just hypothetical but are in production. *Cu*proBraze is used to manufacture heat exchangers of every size, from small space-heaters to huge radiators for locomotive diesel engines and stationary power plants.

Ironically, one of the first successful *Cu*proBraze operations was a high-volume production line [1]. However, most heat exchanger manufacturers are initially interested in modest production goals.

This *Executive Report* describes a basic production line using an automated two chamber furnace [2].

Starter Furnace Concept

The heart of the *Cu*proBraze process is the furnace. This is one piece of equipment that cannot be replaced with manual labor. The minimal requirements for the *Cu*proBraze process is a twin-chamber furnace: the innermost chamber is for actual brazing and the second chamber is for purging the atmosphere prior to the brazing as well as cooling the part subsequent to brazing.

The total cycle time for this furnace configuration is estimated at 40 to 60 minutes per load, depending on the cooling time, broken down as follows: 10 minutes for purging; 10 minutes for heating up and brazing; and 20 to 40 minutes for cooling. That amounts to 24 to 36 loads per day; or 120 to 180 loads per week for three shifts. For fifty 5-day weeks, that's a production rate of 6,000 to 9,000 loads per year.

Starter Furnace Options

There is no "one size fits all" when it comes to *Cu*proBraze production. The most important first step is to study the marketplace and estimate the types of heat exchangers (size and weight) that your customers require. An important advantage of *Cu*proBraze technology is its adaptability to manufacturing a wide range of heat exchanger products.

Nonetheless, several *Cu*proBraze Alliance members have developed a starter concept to familiarize potential manufacturers with the basic requirements for establishing a *Cu*proBraze production line.

As an example, SECO WARWICK claims to achieve throughput levels up to 10,000 loads per year on its automatic 2-chamber furnace, which allows for a maximum load weight of 50 kg (including fixtures) and a maximum load size of 1 m x 1 m x 200 mm. The 75-kW furnace is electrically heated, although a gas-fired option is also available.

It consumes nitrogen (5-ppm oxygen) at a maximum rate of 40 cubic meters per hour.

Furnace throughput could be doubled by adding a third chamber, which would allow a second batch to be purged and brazed while the first batch cools. For the SECO WARWICK model, this option must be

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For information about the *Cu*proBraze process or ICA's *Cu*proBraze consulting services, please contact the International Copper Association at: cuprobraze@copper.org.
For European inquiries contact: ndc@eurocopper.org.

References

1. The SHAAZ production line is shown in a video that is available in English, Japanese and Mandarin Chinese at www.cuprobraze.com/over_video.asp (or select "Video" in Overview pull-down menu).
2. An animated illustration of the two-chamber furnace can be found online, also at www.cuprobraze.com/over_video.asp (or select "Video" in Overview pull-down menu).
3. For a detailed description go to www.cuprobraze.com/over_presentations.asp (or select "Presentations" in the Overview pull-down menu).

The addition of a third chamber can double throughput by allowing the brazing chamber to be reloaded while the previous load cools.

specified when initially ordering the two-chamber furnace. In this manner, the heat-exchanger manufacturer has an option to double throughput while making a lower cost initial investment.

There are various other options available for automated two-chamber and three-chamber furnaces. For more information, the reader should contact furnace makers directly.

Core Assembly and Header Paste Application

While the furnace is the heart of *Cu*proBraze production, the assembly of heat exchanger cores is likely to involve the most labor. Here the manufacturer has a great deal of flexibility.

For tubes, it is possible to 1) purchase coated tubes; 2) purchase uncoated tubes; or 3) weld the tubes in-house. For the latter two options, the manufacturer will need to invest in frames for fixing tubes and an HVLP (high velocity, low pressure) spray gun as well as a drying furnace. Tubes can be manually sprayed.

Nearly all manufacturers will invest in a fin machine which converts fin strip into serpentine fins. Coated tubes, fins and brass headers are brought together on a core assembly table.

Paste can be applied to the brass headers manually with a squeeze bottle, or it can be applied using automated equipment. The latter offers the advantage of uniformity and hence better process control; but the former can also be reliable. The header paste must be dried after application, typically by placing the core in a drying box or oven. The assembled core is then transported to the furnace.

Two-chamber furnace for a low cost production line.

Experience shows that many steps of a *Cu*proBraze production line can be performed manually or semi-automatically, using specialized machinery. Although performing these steps manually may appear to be the lowest cost option, a lot depends on the part size, the desired throughput and the local labor market. As an approximation, 2-3 men would be required for the paste application steps including the furnace operation.

Summary and Conclusion

In summary, a major advantage of the *Cu*proBraze technology is its flexibility and scalability. Any manufacturer considering the establishment of a *Cu*proBraze production line should first work with its OEM customers to estimate production requirements in terms of core size, product mix and throughput. Next the right-sized furnace should be selected to meet present and future needs and a decision must be made whether or not to bring tube manufacturing and coating in-house. Finally, a balance needs to be found between automatic equipment and manual labor.

A detailed description of the low-cost starter concept is available online [3]. ■

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