

EXECUTIVE Report

CuproBraze Secrets to Success

Top 12 Reasons Why Copper-Brass Brazing Is Flourishing

CuproBraze now is well-established as a practical technology for the manufacture of heat exchangers made from copper fins and brass tubes. Keeping in mind the saying that “hindsight is more accurate than foresight,” it is worthwhile to determine what factors contributed most to the present success of CuproBraze. A better understanding of the past yields insight into current technology and foresight in future directions.

Furthermore, after reviewing these secrets to success, you can rank them via an online survey at www.cuprobraze.com/poll.asp.

Share your opinions with your peers!

What do *you* think has contributed most to the success of CuproBraze technology to date?

What do *you* think will be most crucial in the years ahead?

What would have to occur for *you* to adopt CuproBraze?

Meanwhile, the editors of the *CuproBraze Executive Report* and members of the CuproBraze Alliance already have compiled several “CuproBraze secrets to success” as follows.

1. High-Volume Production

The establishment of a high-volume production line at SHAAZ in February 2003 demonstrated scalability of CuproBraze. It was a vital step forward and a watershed for materials

suppliers and equipment makers. Soon afterwards, Denso Japan announced that it would manufacture heat exchangers in volume, too, and it established a production line in Osceola, Arkansas. The importance of Denso’s decision to pursue CuproBraze production cannot be underestimated.

2. Tractor Applications

Valtra tractors are among the best known and most admired in the world. The announcement by Valtra Suolahti that CuproBraze radiators and CACs are being installed in its tractors is a major milestone for CuproBraze technology.

3. Locomotive Applications

Bombardier Transportation was the first company to announce the use of CuproBraze heat exchangers in locomotive applications. In this case, they were used in

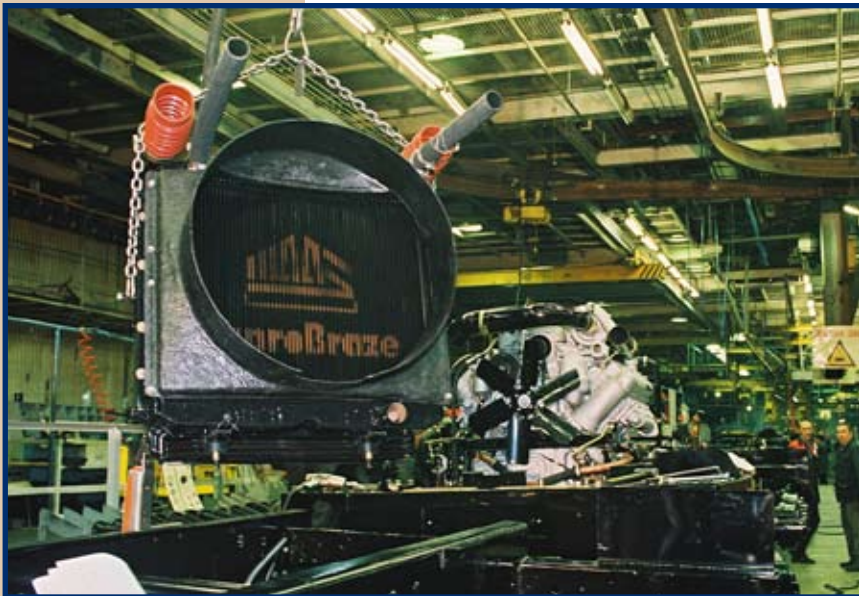


Successful high-volume production first was realized when SHAAZ scaled up the CuproBraze process to supply heat exchangers to all the major truck OEMs in Russia. It employs a continuous-belt furnace (left) and specialized materials-handling machinery (above). See section 1.



The formation of the CuproBrazed Alliance facilitated cooperation between manufacturers, materials suppliers and equipment makers. This photograph from the Tokyo Motor Show shows the founding members of the CuproBrazed Alliance. See section 11.

the overhaul of electric locomotives in South Africa. Subsequently, Young Touchstone announced locomotive applications with several other prominent OEM customers. In fact, locomotive applications are ideally suited for CuproBrazed technology so these applications are stimulating interest in CuproBrazed in many parts of the world.



CuproBrazed charge air coolers offer many advantages compared to their aluminum counterparts, especially for clean diesel engines. Here a CuproBrazed charge-air-cooler and radiator package is being installed in a URAL truck. See section 6.

4. Production in China

The first CuproBrazed line in China was inaugurated in 2004 with much fanfare in Nanning, the capital city of the Guangxi Zhuang Autonomous Region in China. The Nanning Baling Technology Company now supplies CuproBrazed heat exchangers

to a “Who’s Who” list of Chinese OEMs. CuproBrazed technology has generated considerable interest in India as well.

5. Air Conditioning

There is a growing recognition that the CuproBrazed process is well suited for mobile air conditioning, where odors from aluminum air conditioners have been a persistent problem. In March 2008, the U.S. Environmental Protection Agency recognized copper’s ability to kill within 2 hours of contact 99.9% of five specific disease-causing bacteria, including methicillin resistant *staphylococcus aureus* (MRSA). Claims regarding antifungal activity have not been submitted for EPA approval, pending the completion of additional testing. Although antimicrobial copper alloys have not been registered with EPA for use in HVAC applications, the prospects are tantalizing!

6. Clean Diesel

Compared to previous designs of diesel engines, new clean diesel engines place a significantly greater heat load on cooling systems. The US EPA published its Final Rule for heavy-duty trucks in 2001, i.e., the “HD2007” emissions standards. CuproBrazed meets the demand for radiators and charge air coolers with increased cooling capacity. Also, engine manufacturers experience problems with corrosion of aluminum on the coolant side, especially when the coolant is not well maintained. Copper alloys are less sensitive to “bad coolant.”

7. The Brazing Center

Prototypes of radiators and charge air coolers were produced at the Brazing Center in Sweden for many prospective customers. Impressive results were obtained from the testing of prototypes for elevated-temperature fatigue and corrosion resistance in harsh environments. The Brazing Center is managed by Luvata Sweden AB in Finspång, Sweden. Many key advances in CuproBrazed process technology and heat exchanger design can be traced to the Brazing Center.

8. Basic Metallurgy

CuproBrazed technology was born in metallurgical laboratories. An anneal-resistant copper alloy with good heat conductivity for use as a fin material was one essential advance. The anneal-resistant brass alloy for tubes was also a key. Thirdly, the brazing alloy OKC600 alloy was developed and patented for the process. The discovery of OKC600 was an



important achievement because it has the lowest melting point of all the alloys in the CuNiSnP group. The basic process metallurgy had to be proven before the technology could be announced to the world.

9. Technical Literature

CuproBraz technology was introduced into the Society of Automotive Engineers (SAE) technical literature through papers delivered in 2000 and 2001. The first edition of “The *CuproBraz* Handbook” also was published around the same time period. This handbook is now in its eighth edition and is available free-of-charge from the *CuproBraz* Alliance.

10. Applications Engineering

The early adopters of *CuproBraz* technology were pioneers. Many people continually improved the brazing processes. Furnace makers, equipment makers, brazing material suppliers and heat exchanger manufacturers all were active in applications engineering. Today, *CuproBraz* is a practical technology because of years of improvements to the processes and materials.

11. The Alliance

In the beginning, ICA acted as an umbrella organization for the development of *CuproBraz* technology but many interested parties such as furnace makers and equipment makers were not affiliated with the copper industry and could not become members of ICA. Consequently, twelve companies joined

in an industry alliance to advance the use of *CuproBraz* globally. The original alliance included five materials suppliers, one furnace maker, one equipment maker, four heat exchanger manufacturers and one support group (i.e., ICA). The *CuproBraz* Alliance is still going strong. ICA still plays an important promotional role and is an active member in

CuproBraz entered China by way of the Nanning Baling Technology Co., Ltd. The plant inauguration was marked by a festive ceremony. See section 4.



Alliance.

12. The Brand

The emerging technology for brazing copper and brass needed a name. Joining the prefix *cupro-* meaning “copper” to the word “braz,” the International Copper Association in 1996 filed the word mark “CUPROBRAZE” as a service mark for consultation and technical

CuproBraz is ideally suited for diesel and electric locomotive applications. Bombardier overhauled in 45 Class E Locomotives for South African Railways, installing *CuproBraz* heat exchangers for cooling the transformer oil. See section 3.

The International Copper Association, Ltd. (ICA)

The International Copper Association, Ltd. (ICA) is the leading organization for promoting the use of copper worldwide. The Association's 38 member companies represent about 80 percent of the world's refined copper output. ICA's mission is to promote the use of copper by communicating the unique attributes that make this sustainable element an essential contributor to the formation of life, to advances in science and technology, and to a higher standard of living worldwide.

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

References

The 12 reference numbers below correspond to the 12 numbered sections in this report. Executive Report (ER) numbers, titles and PDF files are listed on the "ICA Executive Report" web page, whose URL is www.cuprobraz.com/lit_er.asp. This web page is also accessible via the "Literature" pull-down menu.

1. High-Volume Production: ER-27 and ER-36. See www.cuprobraz.com/over_video.asp for video in English, Japanese and Chinese (Mandarin)
2. Tractor Applications: ER-55, ER-57 and ER-60
3. Locomotive Applications : ER-51, ER-55 and ER-57.
4. Production in China: ER-38, ER-45 and ER-48.
5. Air Conditioning: ER-52 and ER-56
6. Clean Diesel: ER-21, ER-37 and ER-50.
7. The Brazing Center: ER-41, ER-42 and ER-46.
8. Basic Metallurgy: ER-19 and ER-47.
9. Technical Literature: These seminal papers are identified at www.cuprobraz.com on the "Technical Literature" Web page URL www.cuprobraz.com/lit_braz.asp which is also accessible via the "Literature" pull-down menu. These papers can be ordered from the SAE online store.
10. Applications Engineering: ER-20, ER-22, ER-23, ER-30, ER-33 and ER-35.
11. The Alliance: ER-28. Visit www.cuprobraz.com for information about joining this alliance.
12. The Brand
Word Mark: CUPROBRAZE
Filing Date: October 30, 1996.
Registration Date: March 2, 1999,
Registration Number: 2229409

research in the field of copper brazing. Registration was granted in March 1999. The name stuck and the rest is history.

The Major Turning Point

Although each of the above contributed to the success of *CuproBraz*e technology, opinions vary about the major turning point. To shine some light on this matter, you are invited to participate in an online opinion poll. You will be asked to evaluate the relative importance of the above 12 factors.

What do *you* believe is the secret to success for *CuproBraz*e technology?

What will be the key to your adoption of *CuproBraz*e technology?

The survey is easy to complete and will allow you to share your thoughts with others. You can begin the survey now by visiting the survey page on the web site for the *CuproBraz*e Alliance at www.cuprobraz.com/poll.asp. ■



Off-highway construction and agricultural equipment benefit from the durability and cooling efficiency of *CuproBraz*e heat exchangers. Valtra Suolahti uses *CuproBraz*e heat exchangers in all current models, including the N Series tractor shown here. See section 2.



Pictured here is one recent triumph of application engineering: a charge-air cooler made by one-shot brazing, which required careful engineering of paste formulas, paste application and furnace cycles. See section 10.