



Ceramic Imaging's Digital Revolution

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► **Digital ceramic printing provides mass customization and has opened a host of new market opportunities.**

All manufacturers are striving for greater margins, and it is almost equally universal that customers are looking for greater personalization. The commercialization of digital ceramic printing systems using electrostatic laser printers is making both goals achievable at an attractive return on investment. From a single client logo on a BBQ grill to 1000 sinks with various ski scenes for a resort development, digital ceramic printing is the “end game” in mass customization and has opened a host of new market opportunities for companies that have adopted its use.

In much the same way that digital technologies are revolutionizing the photography and conventional printing industries, digital ceramic printing is revolutionizing ceramic decoration with its small environmental footprint, computer-to-print simplicity and 600 dpi image resolution. In commercial use, items as diverse as photo-

graphs preserved in porcelain for mounting on cemetery stones, images permanently fired onto a porcelain enameled dental crown, custom tile murals with commercial ceramic durability, food-safe custom tableware, photographic quality swimming pool murals, bar coding, rapid prototyping and others are being produced.

Technology Development

Work is ongoing for the development of ink jet ceramic printing, and a number of companies are trying to solve the technical hurdles of creating ceramic pigment slurry ink sets and specially designed drop on demand (DOD) ink jet print heads. To date, no widely available low-cost ceramic ink jet printing device has hit the market. Two main schools of thought exist regarding the viability of ink jet for printing ceramic images.

One view is that ceramic ink jet will become the standard for ceramic printing in much the same way it has become the



Caption

standard for conventional desktop printing. A number of companies that share that view are investing heavily in ceramic ink jet, and there are a number of motivators for doing so, including the success of desktop ink jet printing, the large market opportunity for any company that is successful in commercializing an affordable ceramic ink jet printer, and the lack of any obvious alternative since electrostatic laser ceramic imaging is already commercial and covered by a robust patent estate. In addition, given 20 years of DOD development in conventional printing end uses, it seems clear that ceramic ink jet printers are inevitable.

The alternate view is that, while ink jet is ideally suited for printing organic ink sets, it is equally ill suited for firing a high-velocity slurry of ceramic pigments. The technical hurdles that must be overcome are significant. First is the difficulty of creating ceramic pigments small enough to pass through the typical DOD print head orifice. The second and most difficult of the technical challenges is the development of a print head orifice material capable of maintaining a microscopic drop size while withstanding the long-term abrasive wear of high-velocity ceramic pigment slurries. In fact, this abrasive wear problem redirected the development efforts that ultimately led to electrostatic laser digital ceramic printing.

A Laser Alternative

Electrostatic laser ceramic print technology was first patented in 1993 by Michael

Zimmer, a German inventor. Zimmer's system, the first digital ceramic printing system in the world, uses modified off-the-shelf office copiers and specially formulated ceramic toners and developer mixtures. Since filing his first patent 15 years ago, the patent estate on this technology has expanded to 42 individual patents on various aspects of the technology, and the use of his system is expanding worldwide. MZ Toner Technologies GmbH, the company Zimmer formed to develop and commercialize his digital ceramic printing technology, continues to expand and improve the usefulness of the technology in cooperation with a number of partner companies around the world.*

The Zimmer system is based on off-the-shelf two-component (toner and developer) office copiers. The use of commercial printing equipment simplifies and dramatically improves service availability as local on-site service is available essentially everywhere. A number of different copier brands have been evaluated, including Canon, Toshiba, Xerox, Ricoh, Konica-Minolta and others, but the Canon CLC copiers are the most widely used.

First launched on the Canon CLC 500 series, the system was quickly migrated to the CLC 700. Those first-generation systems became legendary for their complexity, instability, unreliability and pixilated images. The Canon CLC 500, 700, 900 and 1100 series copiers all feature component-level architecture with potentially hundreds of individual parts that might need replacement. The users' ability to diagnosis problems depended on interpreting error codes that pointed in a direction but did not necessarily identify what needed replacing. Needless to say, these systems required substantial mechanical aptitude.

Over time, the march from the CLC 500 to the CLC 1180 series Canon copier significantly improved stability, reliability and print quality. While a few early-generation systems are still in operation, expansion of the technology in North America has been the result of the significant improvements in the CLC 1180 platform. Along with the equipment improvements brought about by the CLC

1180, several reformulations of the toner and developer eliminated the grainy look of images printed with first- and second-generation systems.

An Upgraded System

The most recent equipment upgrade, introduced in January of this year, has moved beyond the Canon platform entirely and onto a new sub-assembly base: LED imaging technology with fewer than six parts. The system is very close to offering plug-and-play simplicity. It prints at 600 dpi image resolution with very smooth gradients, high reliability and sealed toner bottles. If desired, the system can print both standard organic toners and ceramic toners on the same piece of equipment.

Essentially, any ceramic surface, including porcelain-enameled metal, can be customized easily. The five different ceramic toner formulations, each a four-color toner set, include leaded and lead-free magenta and selenium red formulations, and a lead-free in-glaze CMYK toner formulation.

The Digital Future

A full R&D effort continues to enhance and extend the technology into a broader array of targeted end uses. In 2008, for example, a reformulated glass decorating toner set will be made available. In the years ahead, new equipment and toner formulations will continue to be rolled out, and direct-to-substrate printing technologies could also be a possibility.

Latest-generation equipment and toner formulations have resulted in a commercially robust manufacturing platform that can economically expand business opportunities and offer personalized products specific to each customer. The system can be a potent weapon in delivering higher value to customers and differentiating product offerings from the onslaught of inexpensive mass-produced products from Asia. 🌐

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*Partner companies include Enduring Images, LLC in North America, Digital Ceramic Solutions (DCS) in the UK and several others in Europe and Asia.