

# TECHNICAL GUIDE

## SUBSTRATES

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AN INTRODUCTION TO PRINTING  
ON CERAMIC TILES AND DECALS

Second Edition



## Printing on ceramic tiles and decals

There are many product applications in ceramics, from tiles to plates, mugs and bottles (hollow-ware) that are decorated using both screen and digital printing techniques. Digital printing has enabled new forms of personalisation and short run production to enhance the well-established applications that are screen or litho-printed.

When it comes to innovation, there is a saying which goes: “don’t change it unless you have at least three good reasons to do so” and this applies to the opportunities for digital printing in ceramics as well. Here we explore some the benefits of digitally printing ceramic products, especially for short runs. We also look at the factors to consider in a complete system for digital ceramic tile production, including choices of ink, printheads, printing device, as well as pre- and post-print processes.

The production of ceramic tiles is one of the oldest crafts in civilisation, so there are well established standards in terms of quality that screen and litho printing have achieved for generations.





*Grafica Flextronica cylinder screen press and wicket dryer for high speed production of ceramic decals where transfer paper is very heat sensitive.*

The challenge for digital processes is to at least meet such quality demands, although some of the metallic and spot colour ceramic transfers still remain beyond digital's capability. The chance however to add something new is always possible.

## Some benefits with digital

If you look at industrial decoration and printing on tiles it's mainly been done using specially engineered screen printing presses. They require make ready and set up of screens which can be time consuming therefore less attractive for short runs, and also demand high levels of knowledge and experience for successful printing. The final results can't be judged until the tile has been through the oven or kiln which does present challenges in sampling as remakes are more costly than using digital.

Whilst higher resolution and image quality improvements are believed to be clear benefits of digital printing when compared to the quality of other processes this isn't so clear as analogue methods already achieve stunning quality. Digital offers unarguable savings in sampling and reduced waste, both of time in set-up, and of materials including ink, screens and tiles, during the make ready phase.



*For very short run ceramic tile print production, where durability isn't too much of a concern, you don't need an oven or kiln, to bake and finish the tiles. But in industrial production it's a must.*



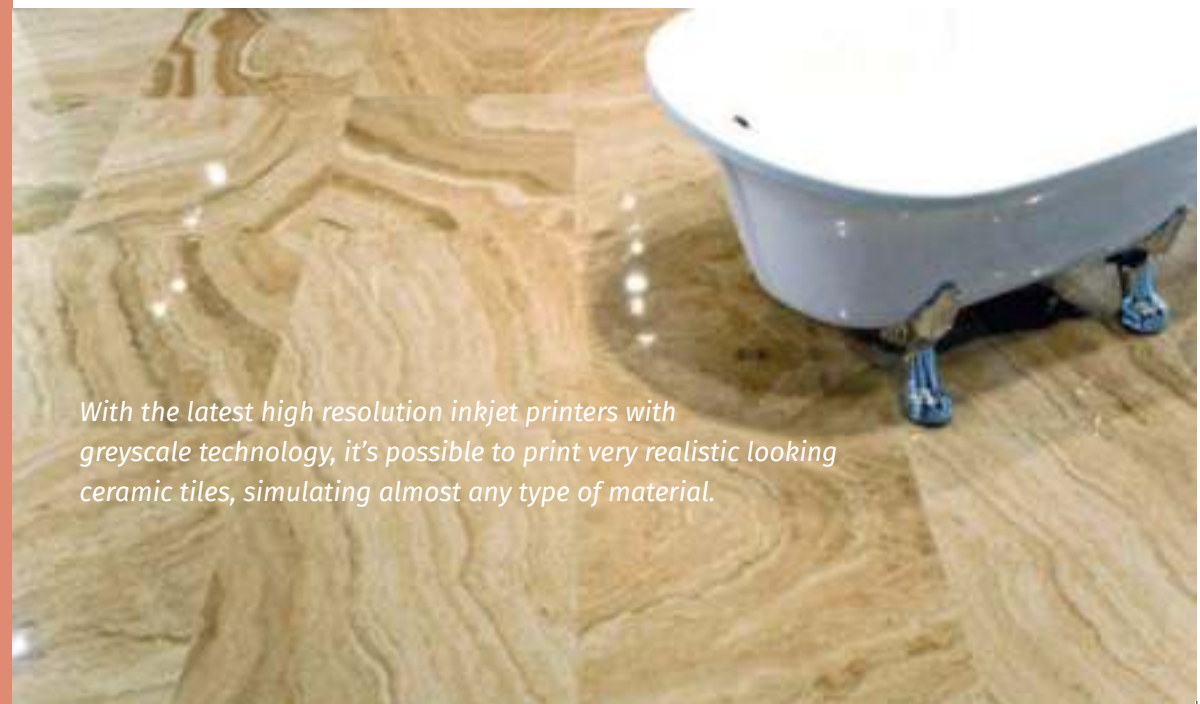
*Ceramic woodgrain tiles at Durst HQ, Brixen Italy.*

Another area that can be challenging when using conventional printing technology is managing colours properly as colour matching with ceramic frit inks have to be fired to reveal their finished colour shades. With digital printing this is more straight-forward to control, and since the different parameters during setup can be monitored and managed through a combination of hardware and software, we will have a simplified end result.

A third area to include when analysing if and how digital can offer improvements to the ceramic tile production process, is at the design stage when planning for

example repeat patterns. When handling this through dedicated software, changes and modifications to the artwork can be made instantly, and necessary fine tuning can be applied immediately. This means more freedom in the design stage and more opportunities for new types of applications – another additional benefit with digital.

A whole floor could for example be designed to be made up of many single tiles that together make up a very large picture. Those chosen pictures or illustrations can be selected on demand and be printed in very short print runs, down to a single set for a specific customer. Print-on-demand is the third powerful attraction of digital tile production.



*With the latest high resolution inkjet printers with greyscale technology, it's possible to print very realistic looking ceramic tiles, simulating almost any type of material.*

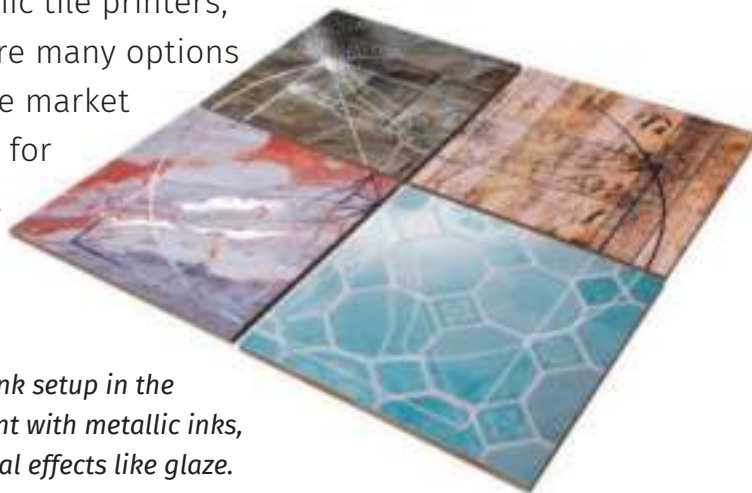


Contrary to screen printing on tiles where relatively flat areas can be printed, with digital printing using inkjet printing technology it's possible to print on more uneven or textured surfaces, and even to create a textured surface. This is because when using inkjet, there is a distance from the printhead to the substrate, whereas with screen printing the squeegee and mesh are in direct contact with it. This is the fourth advantage of digital.

But are there disadvantages with digital printing for ceramic tiles? What about ink for instance, which is normally very expensive for digital printers?

Traditionally tile manufacturers using screen printing ink pay less as it's cheaper to manufacture and performs well in production. This has actually been picked up by manufacturers of digital ceramic tile printers, so that there are many options available on the market for ink suitable for digital printing.

*With an extended ink setup in the printer you can print with metallic inks, and also add special effects like glaze.*



Digital printer manufacturers, in cooperation with the manufacturers of the printheads, test different ink formulations and can advise which inks work well in the particular inkjet tile printer. And with digital inkjet tile printing thanks to electronic control and colour management, it's possible to optimise the amount of ink laid down on the tiles so that none is wasted. In many cases you will save ink when moving to digital production, so we can conclude that we have identified many potential advantages in digital print production of tiles.

## Choose a printing system wisely

Of course there are challenges when preparing to switch to digital production, or in complementing an existing conventional tile printing production line, with a digital one. Not just any type of digital printer will do, and not even any type of inkjet printhead will be suitable for the large particle inks needed when printing on ceramic tiles.

There are fairly simple digital printers on the market using dye sublimation transfer technology to apply the image to the tile. These are similar to the ones used when printing on textiles, like printing on T-shirts and similar. Those types of transfer sheets can actually be printed in more or less standard toner based colour laser printers. But the durability and finish of the tiles printed with this technology is limited, and intended more for hobby use. There is however a toner-based approach where a ceramic toner is used and offers greater durability such as the ceramic toners from MZ Toner Technologies in Germany.

For industrial digital ceramic tile production you need dedicated digital printers able to not only apply the design and colours to the raw tiles (often called the biscuits). You may want to apply special effects like glaze, or lay down liquid clay or slip to add value to the tile's design. In order to be able to do this you need a modular printing system, where more printing units can be added according to your needs.



*Ceramic Toner system from  
DigitalCeramics.com*

In order to jet many types of ink, the printheads need to be customised for digital ceramic tile printing. For example the latest printheads can produce an effective resolution equivalent to 1000 dpi, which is about the limit for what the human eye can discern. It means that the image quality is close to that of high-end photography, so the tiles can imitate real life materials like wood or marble.



*Durst Gamma 208 XD is  
an example of the latest  
inkjet technology for  
ceramic tile production.*



*Efi Cretaprint C4 is another example of industrial inkjet for tile manufacturers.*



Or they can be printed with metallic inks, achieving very special and unique effects. Here we can really say, “only your imagination sets the limits”.

It's key that the ink distribution system in the digital printer is designed to avoid clogged nozzles and uneven print quality. Check that the printing system you are considering has proper ink circulation in place. It's important that the ink circulates effectively in the nozzle, or you will experience not only fluctuations in the print quality, but also increased downtime for maintenance of the printheads. The printing system should also be designed to function in a quite challenging environment, with dust from the raw tiles, and heat from the nearby kiln, or post-print processes like heating or firing the tiles.

Another area to check is if the printheads support grey levels. Many printing systems only provide 1-bit output, meaning, either an ink droplet, or nothing. More advanced printing systems use drop on demand technology using variable droplets sizes, say from 6 pL up to 84 pL drops. This creates a smooth tone reproduction starting with the ink drop itself, coupled with what can be achieved with the screen that is applied for the output. All in all this new technology offers perfect image quality, often surpassing that of conventional printing using methods like screen printing. For the special ink layers used for additional effects you will probably need printheads dedicated for this, producing larger droplets, from 70 up to 180 pL – about 1000 times more than what is used for the colourants. This can be white ink, or the slip and/or glaze.

In the near future it will be possible to add other specialised coatings onto the tiles, like non-slip, antibacterial or water repellent coatings. Or even electrically conductive coatings to make sensors for alarms, lighting or similar functions. There are good reasons to look into digital printing on tiles and there are many opportunities for the wider field of ceramic decoration.

Many printers whose businesses were built on the imaging abilities of screen or litho have added inkjet and ceramic toner transfers to broaden their range of services.

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