



# ***LET'S TALK ABOUT DIGITAL PORCELAIN DECORATION***

***BY SERGIO BARRO***

## **Brief overview**

Since the year 2000 (appearance of the first inkjets) substantial improvements have happened, resulting in these last couple of years “digital fever”.

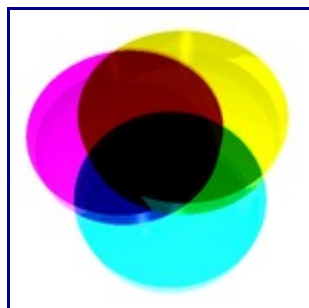
It's becoming “a must” for every respectable manufacturer and consequently tile importer to have and market its digital product/s.

So for the usual same sake of educating ourselves (to possibly compare apple to apple) and above all to give our sales team and consequently the final user (either the A&D community or Mrs. Jones) the “right tools” to work and/or make right distinctions...*Let's talk about digital porcelain decoration.*

## **Digital porcelain Technology**

I'm sure you own or use a printer and you're familiar with the most popular color system CMYK (acronym for Cyan, Magenta, Yellow and Black called K – Key) which when overlapping, generate many more colors.

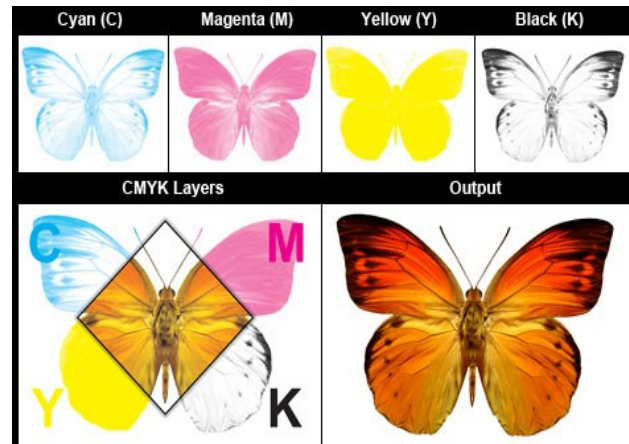
So in digital porcelain technology there's no contact with the tile, unlike traditional ones.



There are different digital decorating machines out there, that can have 3, 4 or 6 inks, working in different ways but all sharing the same basic idea, i.e.:



when they reproduce an image (butterfly, Rojo Alicante marble in this example) the overlaying of colors do the trick.



## How do these “inkjet” work?

There are several printing machines out there (which we'll briefly see later on), however as far as porcelain decoration is concerned, there are 3 basic “printing methods”, i.e.:

- 1) DOD (drop on demand)
- 2) SOD (spray on demand) or Flatjet
- 3) GRAY SCALE (drops of variable size)

Before listing them, I would love to share with you a couple of info. on these amazing machines, i.e.:

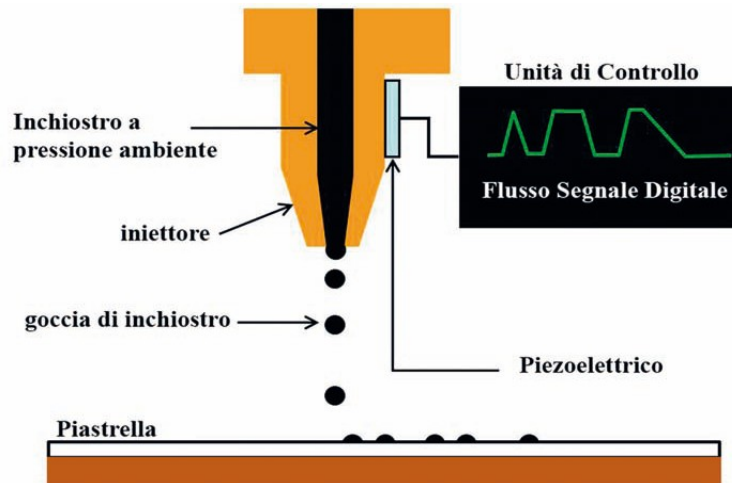
- They can produce up to 1500 sq.m./hour (over 16.000 sq.ft)...of course depending on the resolution.
- They can have up to 1000 dpi resolution (dots per inch) even if normally, 200/300 dpi is sufficient to reproduce stones etc. Just to give you a comparison Rotocolor/Cylinders and silk screen technology have abt. 80 dpi.

I also would love to warn you that, as fascinating as they might look/sound, at present these machines cannot totally substitute traditional decorating methods, especially when you need thicker and more rich decorations or strongly decorated/colored areas. So as usual, after the initial issues (that you might have also read in my old Porcelain Jungle memos) they have incredibly improved and are now a great complement to existing decorating technologies.

## DOD (Binary mode)

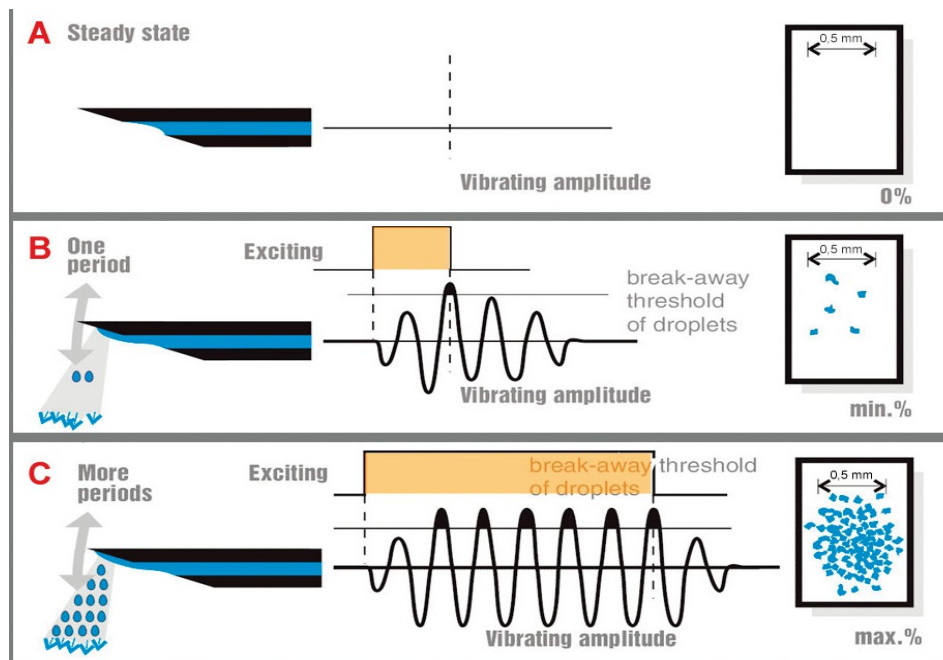
The majority of the inkjet printers use this method.

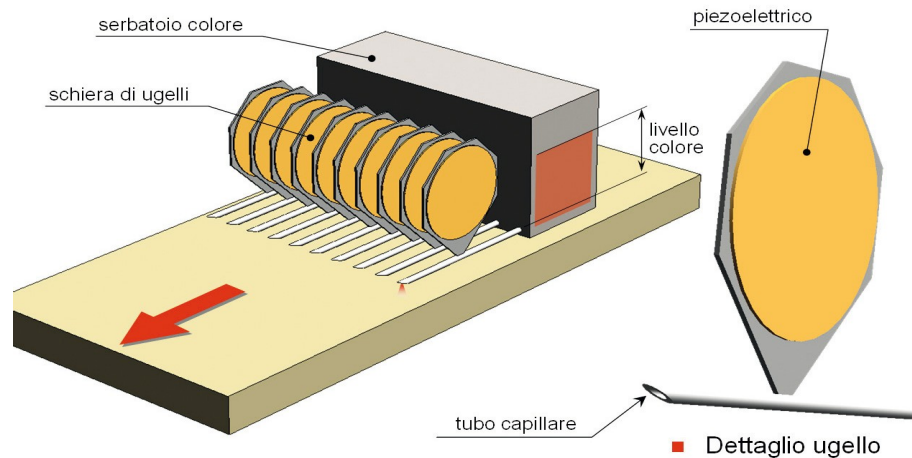
As you can see from the diagram, a “digital signal” deforms the injector and the ink drops are released decorating the passing tile. Drops are of the same size, also called Binary mode.



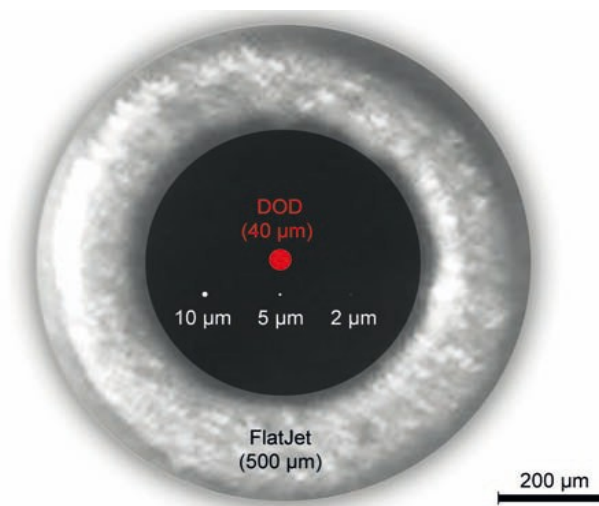
## SOD (Flatjet)

At the moment only Sacmi DWD065 uses this method which allows more dispersion of the color, see the black nozzle and the blue ink on the left and of course the vibrating pulse.





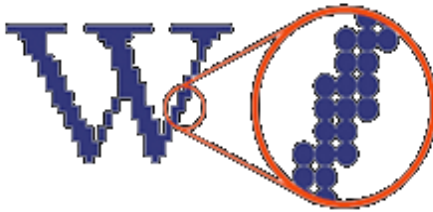
Also note the difference in size of the nozzle, less likely to clog (gray rim) compared to the red dot (DOD) and compared to the ink particles/droplets (white dots)



### GRAY SCALE (drops of variable size)

a few machines are using this printing method at the moment, Gamma75HD (by Durst), CretaPrinter (by Cretaprint) and Xaar (by TF Technology)

Very simply, different size of drops (because of the CMYK color overlaying) create many more shades of colors on top of higher definition.

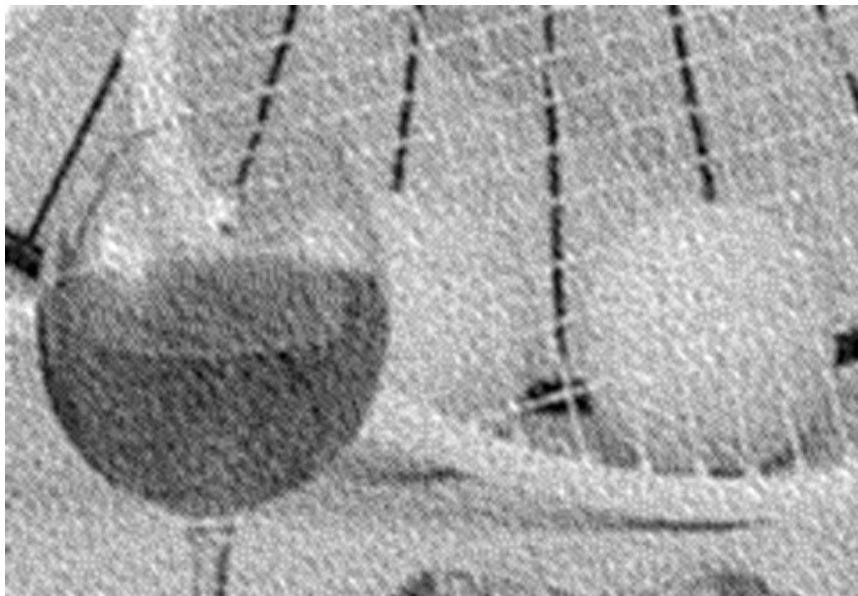


Example 360x360 Dpi (binary mode, i.e. drops always of the same size)

Example 360x360 Dpi (Gray Scale mode, i.e. drops of different volume)

The result is the pixelized (separated dots) are avoided and more uniform color is obtained.

As you can see from the following pictures examples, a Binary method needs to print at abt. double resolution if it needs to match a Gray Scale printing result.



360 dpi Binary Print





360 dpi 6 Level Greyscale Print

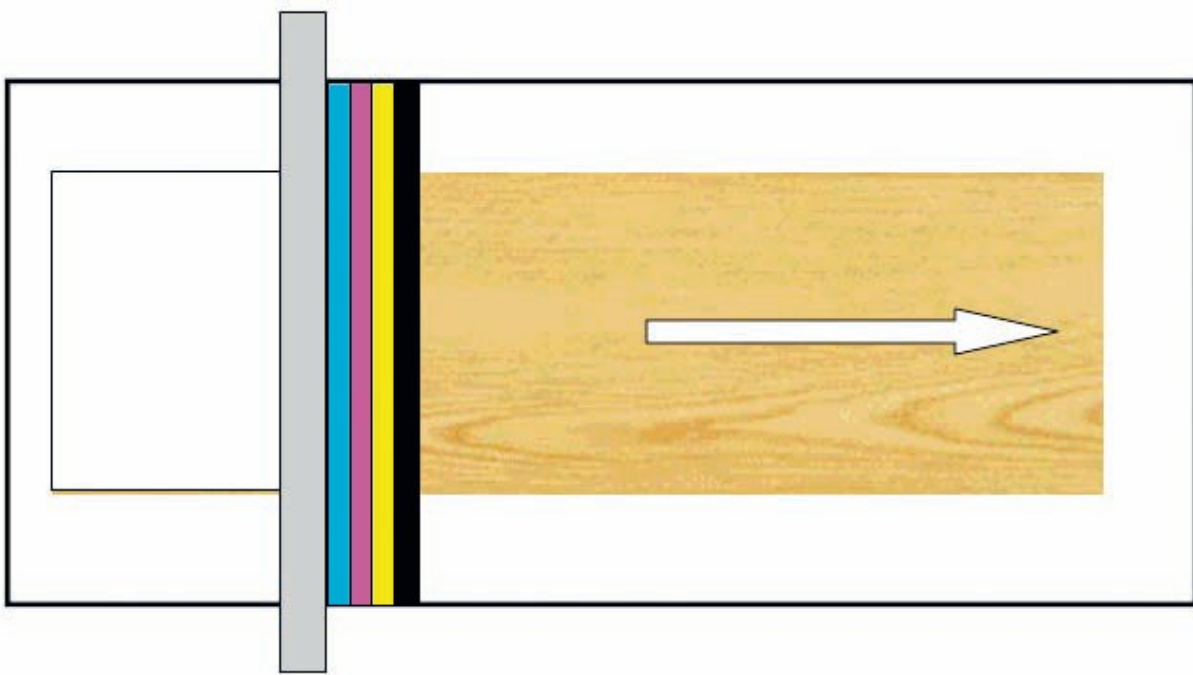


720 dpi Binary Print

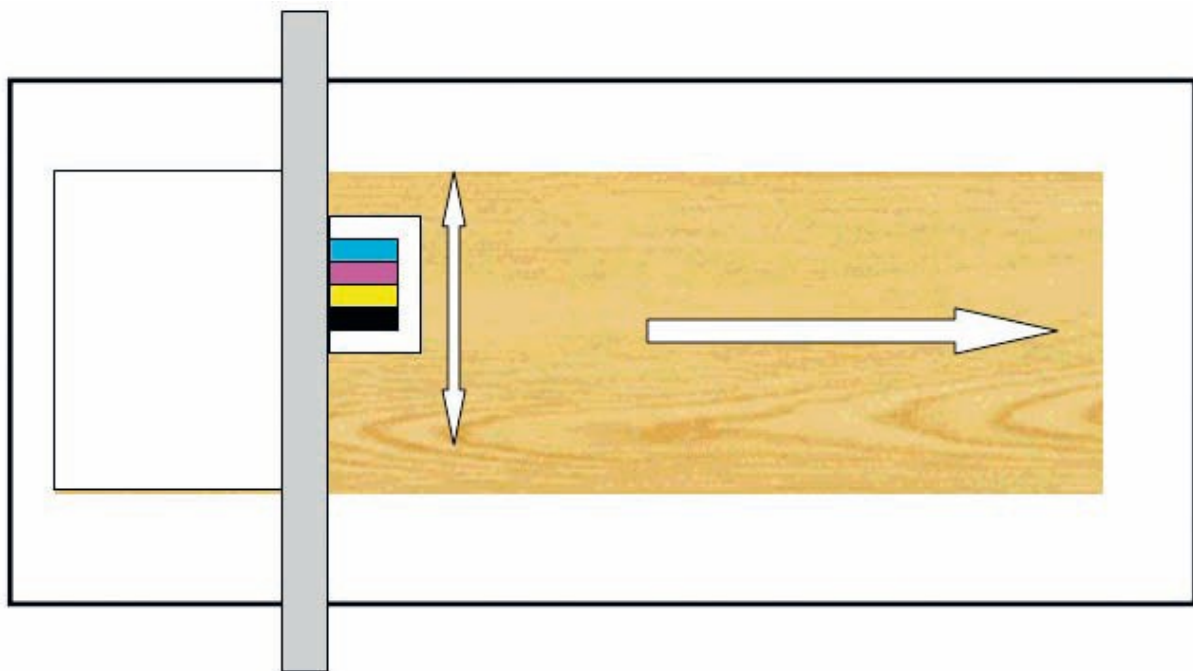
### **Field tiles and trim pcs. inkjet:**

Here a couple of extra examples of digital printing methods.

The first printer is mainly used for field tiles, the second one for decorating special pieces and trims.



Single pass fixed heads (up to 1200 m<sup>2</sup>/hr abt. 13.000 sq.ft./hr.) high investment (moving material) more flexibility



Multipass scanning (abt. 200 m<sup>2</sup> hr/ over 2.000 sq.ft./hr.) low investment (stop and go material) low flexibility.

## Printing challenges:

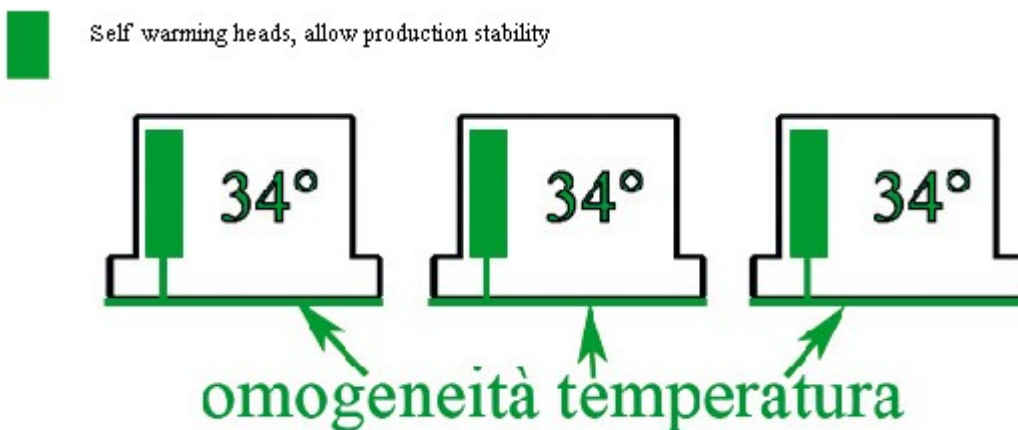
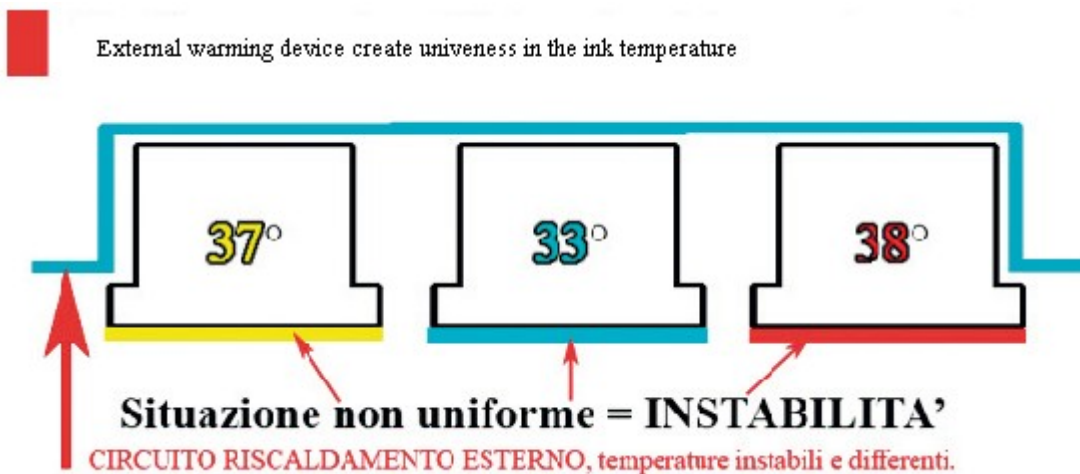
As introduced above one of the challenges in the digital printing is the clogging of the nozzles, creating the so called “banding” (lines, stripes of lack of color).

It has been always a struggle to find:

- 1) the right viscosity of the inks so it does not clog but also does not disappear on the tile body and it dries quickly enough not to interfere with other decorating machines.
- 2) the continuous steering and warming of the inks to create production stability
- 3) the cleaning of the nozzles
- 4) the stability of the inks at firing temperatures btw. 900 and 1200 c.

But also:

1. The right hight of the nozzle
2. The right Khz (kilohertz) intensity



are important factors in the final print, so to avoid blurriness of the design (dispersion of the droplets), shade inconsistency, etc.



Here a couple of pictures

The further from the printing surface, the more likely we experience drops dispersion and consequent printing defects.

Optimal printing area

Too wide of a printing area (wide cone)

High Khz Value

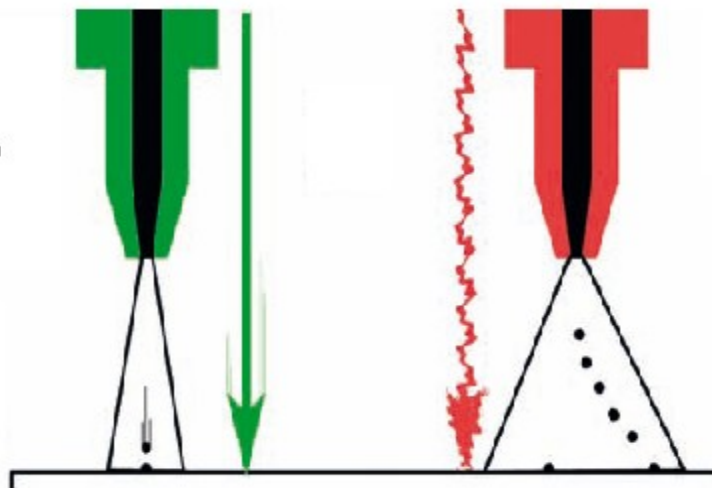
Stable drop speed

abt. 8 m/sec (abt. 25 ft/sec)

Low Khz Value

Unstable drop speed

Dispersion



## Let's look at some of these machines:

Kerajet (by Ferro)

Probably the first, the most know and the most used. DOD method , 4 inks ,100% digital, 500 injectors capable of transmitting 4000 drops/second



Durst Gamma 75 HD (by Durst)

Operates in Grayscale method, 5 inks, high speed and reaches 600 dpi resolution.



DWD 065 (by Sacmi)

Flatjet/spray on demand printing method. Max ink flow, 25 times higher than other inkjet systems.



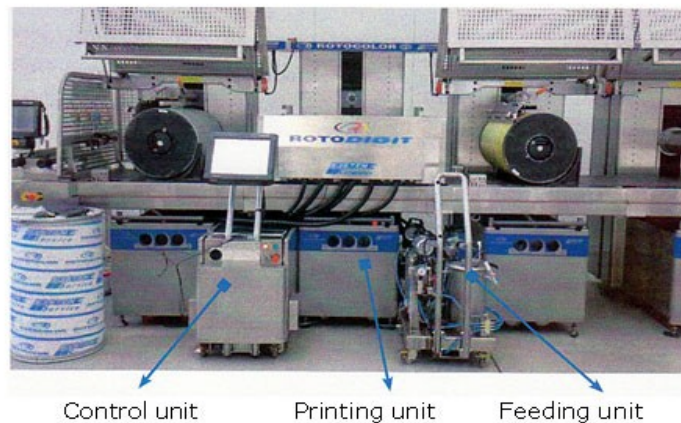
### Cretaprinter (by Cretaprint)

Also this machine works on a Grayscale mode (like Durst 75HD) while all the rest work on Binary mode.



### Rotodigit (by System)

DOD mode, works in synchronization with rotocolors, so allows saving on printing heads which are very expensive.



### Jettable Maverick (by Maverick)

Also DOD can reach 1350 dpi



### Jet Digital Printer 08 (by TSC)

This machine is used to decorate special pieces and trims.



### Colorjet (by TecnoExamina Tecno Ferrari Group)

6 inks bar and flexible enough to be able to use different inks from different manufacturers.



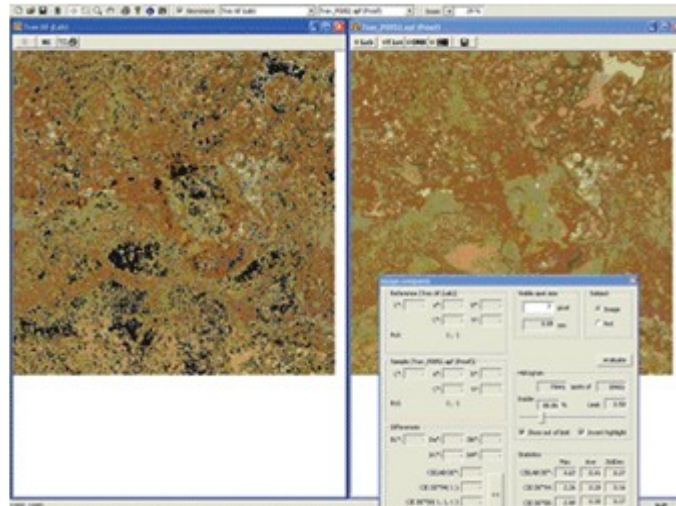
### Xaar (by TF Technology)

Grayscale mode, 7 drop size and great ease of maintaining the nozzle clean, replace heads etc.



## Kerlab (by Officine Smac)

This amazing LAB machine and its system provides a video preview or a printout of a proposed image, on which it is possible to make numerical measurements to evaluate the likelihood of a production match with the original. Decisions can then be made, whether to proceed with reproduction in the factory with the inkjet printing device



## Digital decoration VS silk screen and roller system

To finish up this memo, let's recap and pin point the most important improvements/characteristics of above technologies.

A little bit like the television or the camera industry, digital porcelain has basically improved three-dimensionality, sharpness and depth of colors but also:

- 1) Decoration up to the edges of the tiles (even when distressed)
- 2) Decoration in the shallow and high end of the tiles (avoiding lack of color and cheap look)
- 3) Huge graphic variation (40/60 different faces) VS limited variability of max 1440 mm (4  $\frac{3}{4}$  ft)
- 4) High definition normally abt. 300 dpi (dots per inch) VS the 80 dpi of screen and roller system  
Digital technology can reach up to 1000 dpi but it's generally not needed for tile/stone reproduction, usually needed for pictures reproduction.
- 5) Since non contact printing technology, it allows decoration on top of frits/glazes for amazing translucent effects.

and then again from the manufacturer's standpoint:

- flexible work-flow production runs
- more consistent production
- less storage space for rollers, screens, etc.
- less storage for glazes, pigments, etc.
- simulation of production outcome
- shorter times btw. Product idea and industrialization for instance:



With traditional work-flow, we had the following passages (passage 1 to 5 only first production);

- 1) acquisition of the image/design (marble, travertine, modern etc.)
- 2) create color separation for Rotocolors/silk screen
- 3) engraving test (silicone in the rotocolor) 4 to 8 (one each color)
- 4) correction design, color separation
- 5) engraving final cylinders (4 to 8 one each color)
- 6) mount cylinders
- 7) fill each module with ink
- 8) fine tune color registration and tones (20/30 tiles)
- 9) prepare glaze line
- 10) Monitor contamination, cylinder abrasion, viscosity etc.
- 11) replace cylinders, glaze, etc.
- 12) decorated tile ready to be fired

With inkjet technology:

1. Image acquisition and possibly modification
2. Load file and prepare job
3. Fine/tune color and intensity (2-3 tiles)
4. Digital printing
5. Decorated tile ready to be fired.

So as you can see, a considerable change.

Traditional technology is still very reliable and proved production method, beside the limitation mentioned above, there are many others like:

- Line stoppage for model change
- Long costly process for new designs (btw. 30.000/70.000 Euros)
- Long process in color tone calibration and waste of color
- Not ideal for short production runs

## **So is digital decoration the solution for everyone?**

....so can this technology allow ANYBODY to make great tiles?

Of course not!

- 1) the human factor in maintaining these machines at their peak avoiding “banding” (clogging of the nozzles due to change in temperature or size of the drops)
- 2) the human factor in selecting just the right design
- 3) the human factor that combines traditional technology with digital one for optimal outcome
- 4) the human factor in running the production at just the right color intensity to allow optimal production speed (it can reach 10.000 sq.ft. each hour) without compromising look , nozzles heads and ultimately the price of the tile.
- 5) the human factor of picking the right machine for its production plant, peoples' skills and market share/strategy ones want to be in.

## **Last “food for your thoughts”**

The problem of reproducing accurate and original tones is a constant issue for those who have the task of doing it in a repeatable way.

For ceramic tile manufacturers (unlike printing on paper) the task it's even harder since this decoration is fired at abt. 1200 c which means constant different chemical reaction.

The most important aspect of using digital inkjet decoration is not in the mechanics of it on the glazing line itself. It's the rationalization that must occur to set up the printing process so that it faithfully reproduces the original digital picture despite all of the complex machine setup, ink, pigment, glaze and firing issues.

Therefore it is no surprise that in a manufacturing facility a comprehensive mix of specific expertises are needed: software, hardware, graphics, ceramic production and ceramic engineering specialties.

**I hope you've enjoyed this memo, thank you for reading**

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