23rd International Enamel Congress

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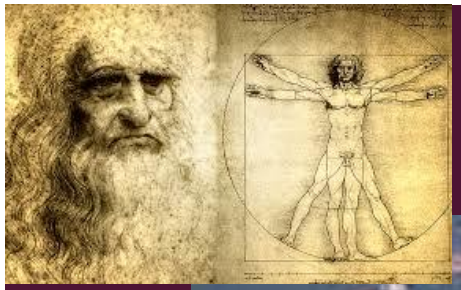
Decoration of enamelled surfaces based on inkjet technology

Angelo Sole – COLOROBBIA

INTERNATIONAL ENAMELLERS CONGRESS FLORENCE



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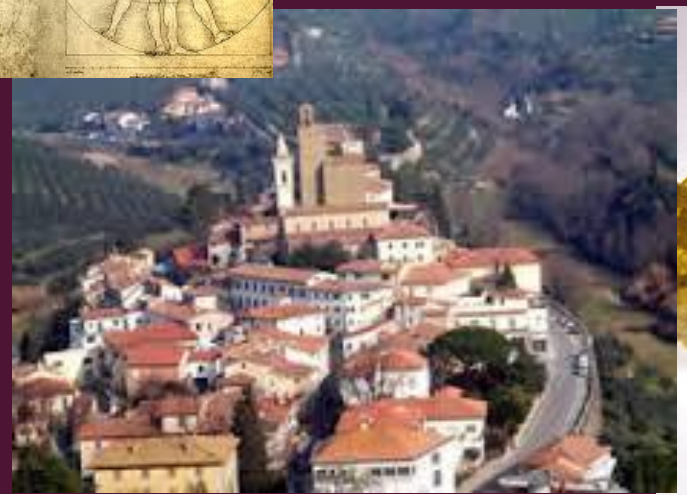

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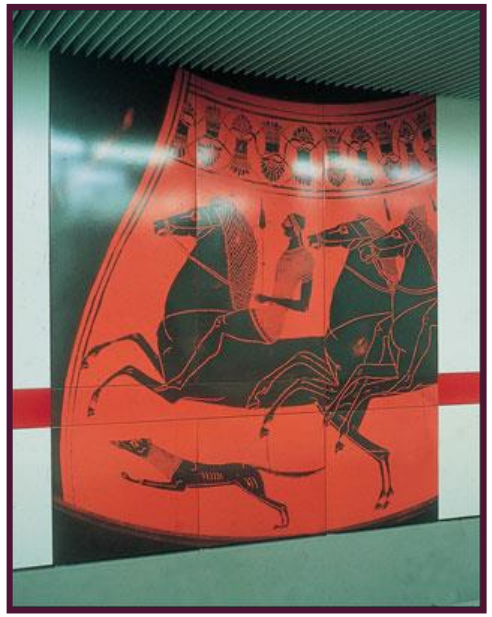
Decoration – application fields

- Architectural panels
- Signage and advertising panels
- Pots and Pans
- Hobs and oven front controls



Decoration – traditional application technologies

- Screen printing
- Decals
- Padprinting
- Others (curtain coating, rotogravure, etc)

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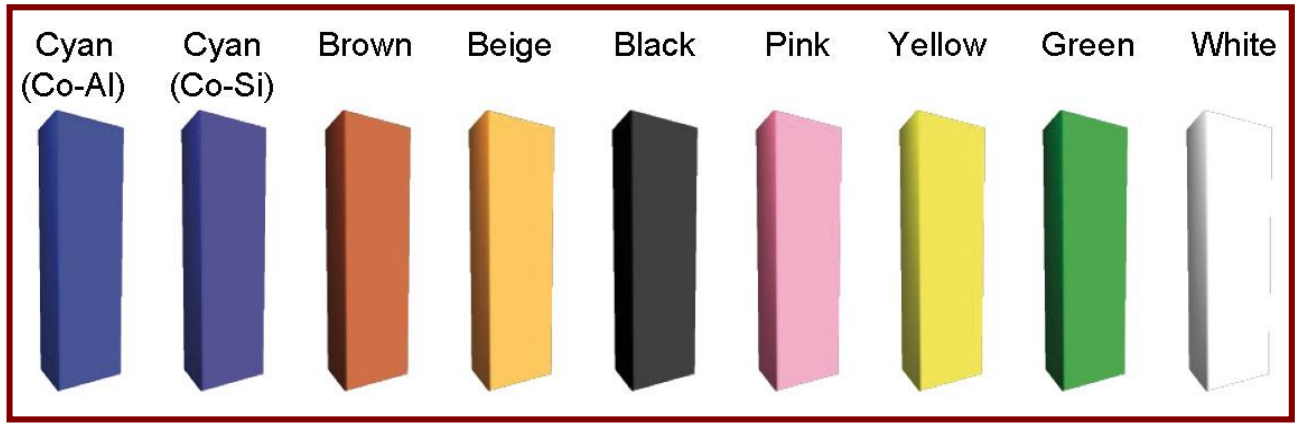
Inkjet digital printing

Introduced few years ago in ceramic industry



At the beginning 4 colour inks combination

- Cyan
- Brown
- Yellow
- Black

Then colorimetric range enlarged with other colours

- Green
- Beige
- Pink

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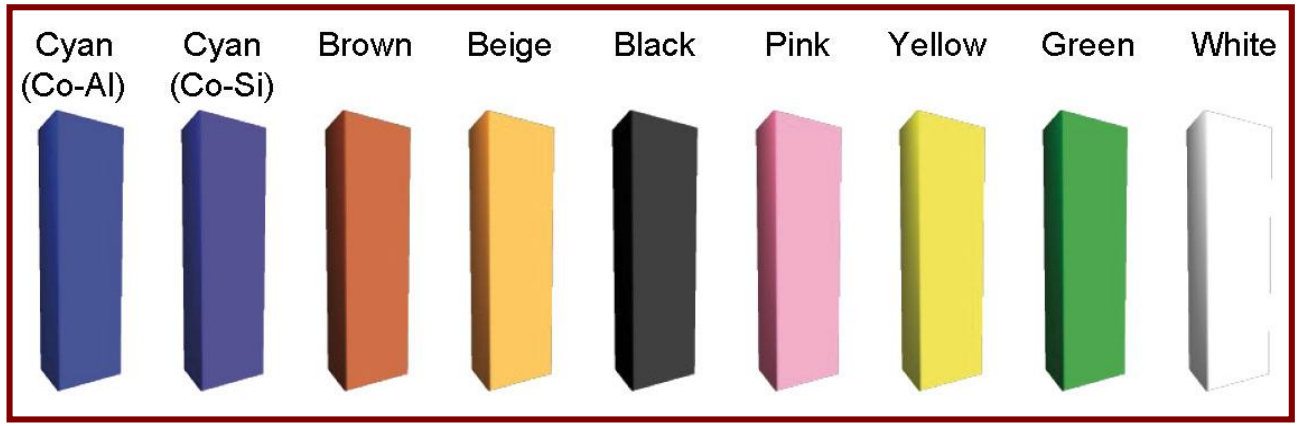
Ink composition

- organic vehicle
- pigments particles in stable colloidal suspension



Ink storage

- Shelf life: 6 months
- Temperature: 20-25°C
- Low humidity
- Absence of dust

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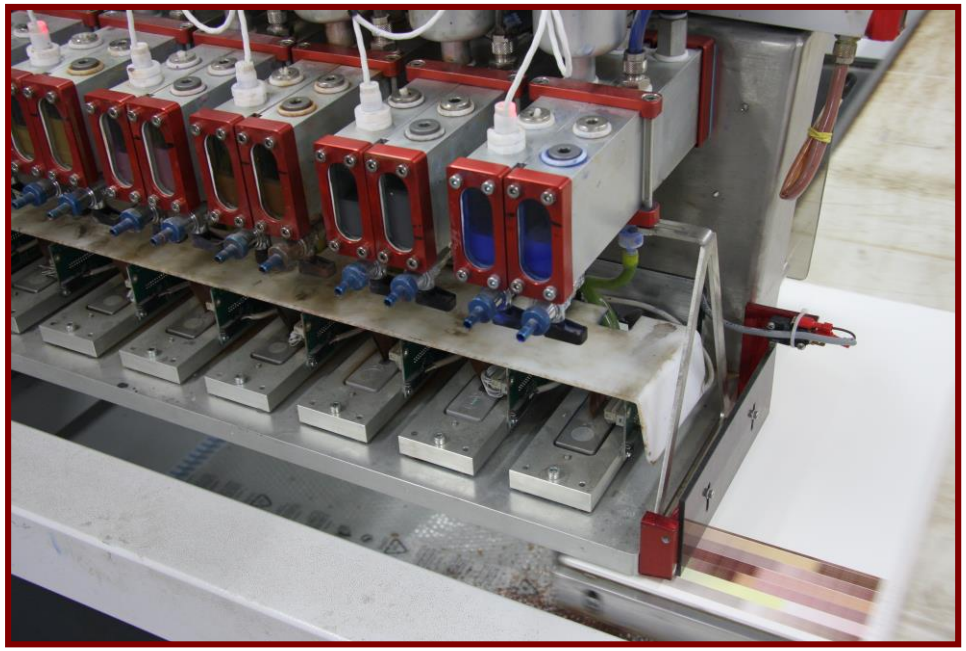
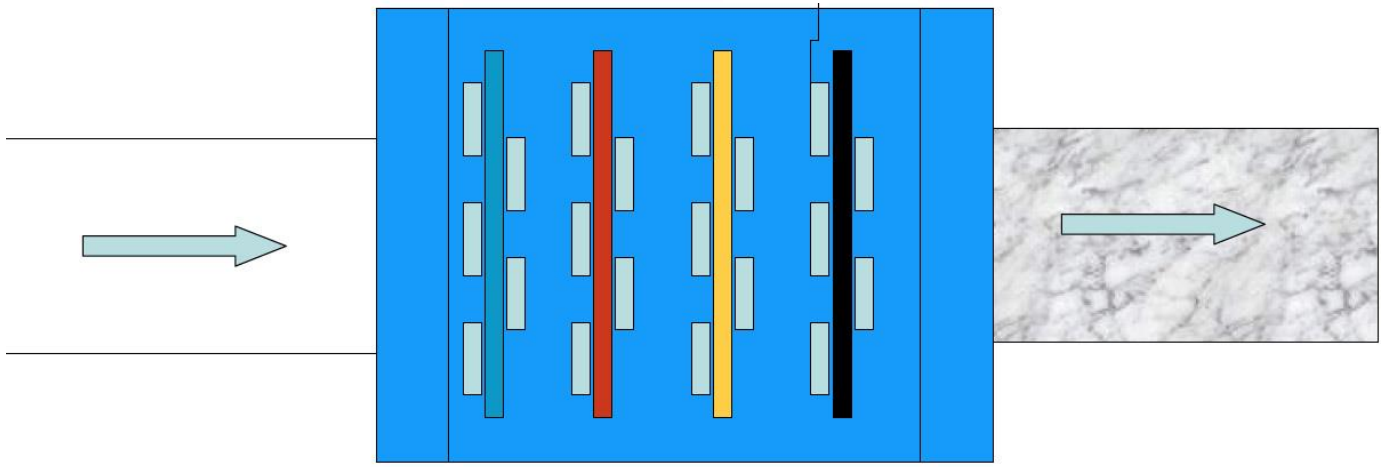
Digital printers - structure

- machines equipped with “bars”
- each “bar” one colour
- each machine from 4 to 6 or more “bars”
- every “bar” is equipped with printheads
- The lenght of a printhead could range from 5 to 7 cm





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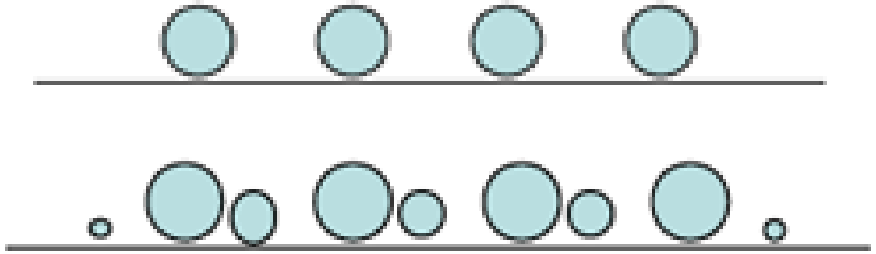
Printheads could work in

- **Binary:** drops of same size
  High ink discharge, few details
- **Grey scale:** drops from 2 to 4 sizes
  Low/Medium ink discharge, shadows and details



Drop size

Basic **drop size** is 12 pl (12×10^{-12} l)

Bigger drops obtained as multiple of the basic drop up to 200 pl.

Distance between printhead and piece

From 2 to 5 mm, up to max 10 mm.

The higher the distance the lower the resolution

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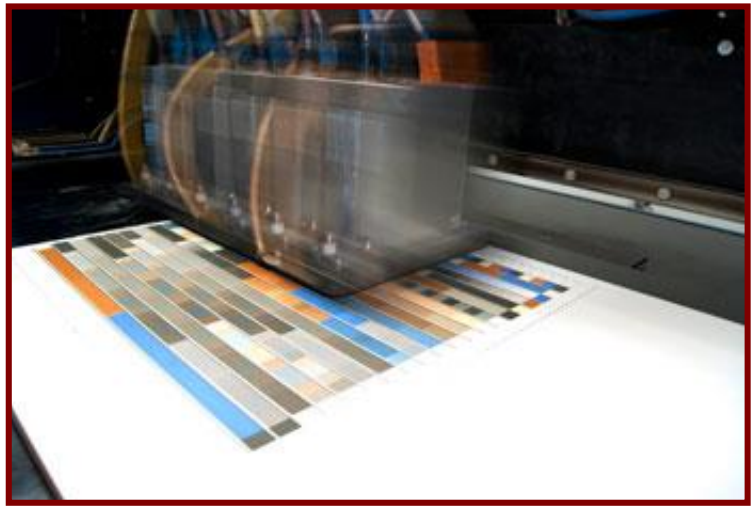
Application on Porcelain Enamel

Support should be rought or porous => enamel applied by wet application and dried

Need to make a **“profile”** with following variables:

- **Enamel** base coat
- **Firing** conditions
- **Colours** configuration
- **Digital printer**



The “profile” fix the colour development once defined the up mentioned conditions

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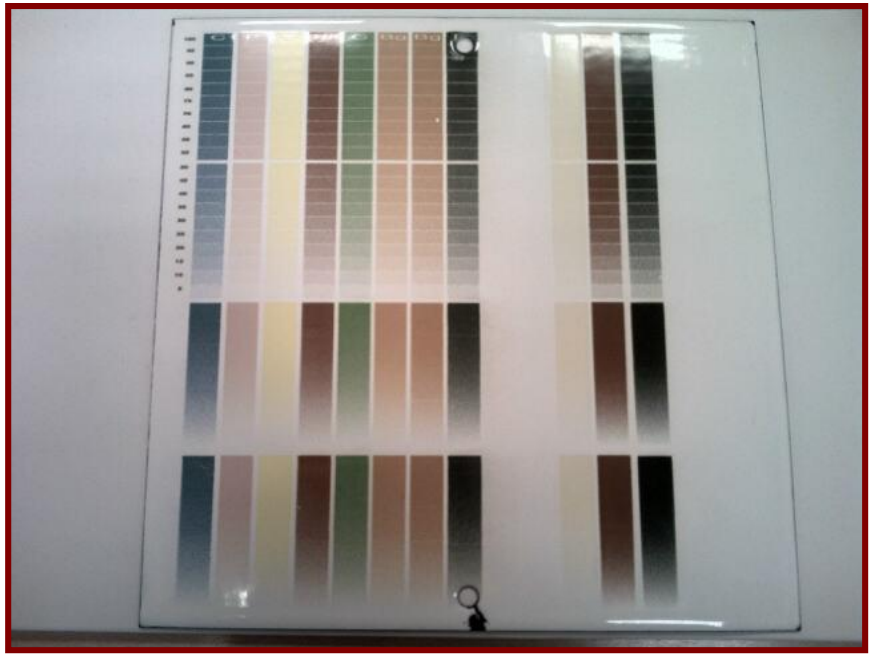
Results of investigation:

- Ground coat and direct on enamels doesn’t develop the colours
- Cover coat enamels (transparent, semi-opaque, white frits) develop the colours
- Colour development improve moving in direction of white frits



Remarks

- Enamel surface after ink application loose gloss
- A 30-40 µm top coat glaze could improve gloss
- Good abrasion and scratch resistance
- Chemical resistance similar to enamel

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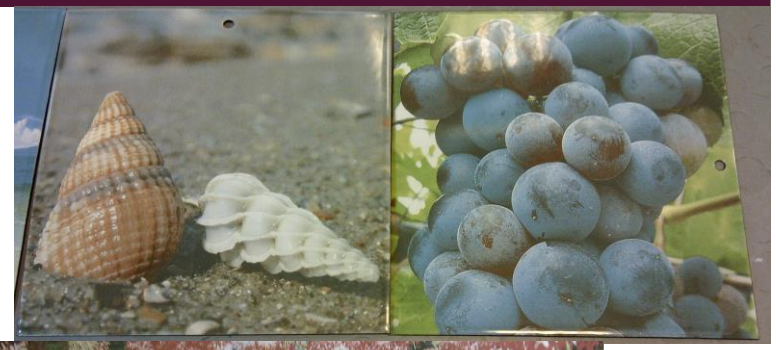
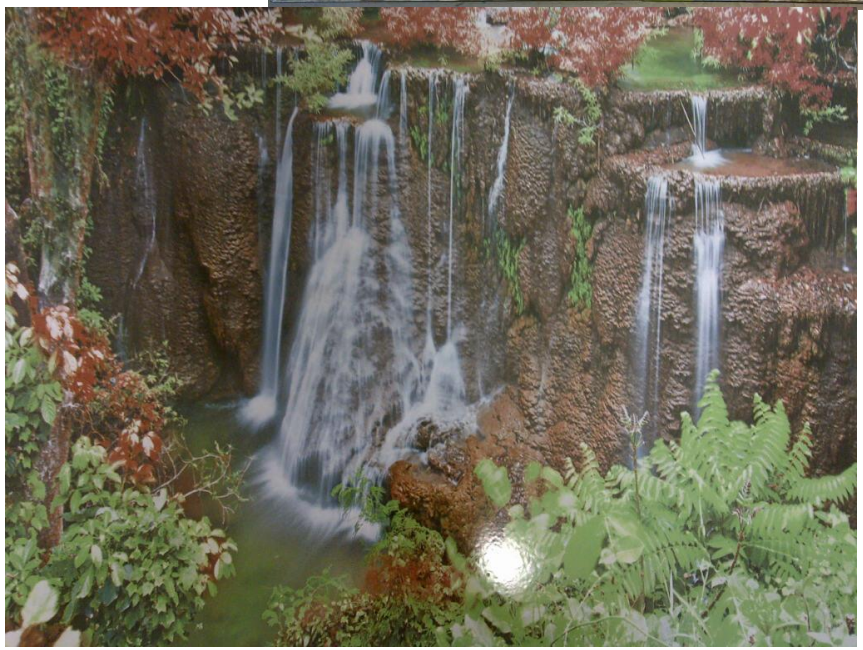
Remarks:

- Piece surface perfectly flat
- Possible in theory to develop digital printers with movable printheads
- Application on dry cover coat enamel (DWE, 2c/1f, 2c/2f)
- Resolution and color range dependent on initial investment
- Not possible intense red, orange, yellow and violet
- Gloss could be mantained with a top cover glaze





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CONCLUSIONS

Digital printing possible on Porcelain enamel

Main constrains with actual technology

- pieces flatness
- decoration applied on dried cover coat enamel
- initial investment

Main advantages

- possibility to make complex pictures
- higher productivity and lower cost respect to actual technologies
- high automation level

THANKS FOR THE ATTENTION

AVAILABLE FOR ANY QUESTION