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Ph.D. thesis (2020-2023)  
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# Correlation between water based ink formulation for inkjet, their physico-chemistry properties and their jetting performances

*Corrélation entre la formulation d'encre à base d'eau pour l'impression jet d'encre, leurs propriétés physico-chimiques et leurs performances en impression*

## Context

Print on PVC substrate for flooring applications

### Advantages of using digital printing process

- No printing form : **design** to be printed can be **infinite**;
- Numbers of **colours** can be **unlimited**;
- Process without contact neither pressure;
- Well-adapted process for large and small print runs;
- **No limit** for the **length** of the **patterns**;
- **Handling** and **cleaning limited** to printheads;
- **Ink** consumption is **limited** to the printing area.

### Limits of the process

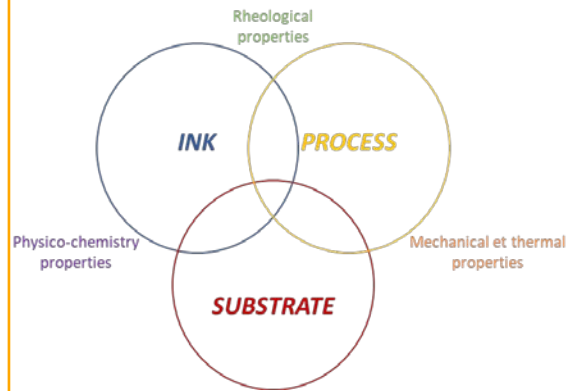
- Process is not fully mastered;
- Different **defects**: white lines, latency, satellites, etc.;
- **Low printing speed** : 10 to 15m/min;
- Need an excellent **matching between the ink, the printhead and the substrate**.



[https://particuliers.tarkett.fr/fr\\_FR/collectif-on-C000262-startfloor-click-30/retro-orange-blue](https://particuliers.tarkett.fr/fr_FR/collectif-on-C000262-startfloor-click-30/retro-orange-blue)

## Objectives

Understand the [Process/Ink/Substrate] system



### [Formulation – Polymers]

Study of the impact of the **raw materials** used as **dispersing agents** and **binders** on the stability of inks, their rheology and their jetting behaviour

### [Process – Ink ejection]

Study of the relation between the rheological and physico-chemical parameters of the inks and their **jetting parameters**: waveform, frequency, temperature, etc. Avoid formation of satellites, clogged nozzles, latency.

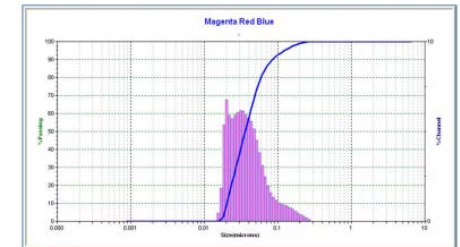
### [Substrate – Interaction with ink]

Achieve the **requirements** in terms of adhesion, color, wettability, precision of the design.

## Methods

### Colloidal stability study

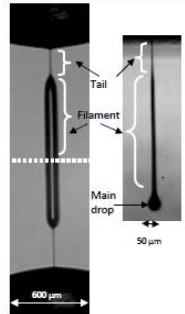
- Particle Size Analyser
- Spectrophotometer
- Filtration tests
- Ageing tests
- Zeta potential



[https://www.microtrac.com/dltmp/www/5e788a7d-9470-4131-9c88-444ec3c9c754-0afb8baf8247/microtrac\\_sl-an-22\\_d.pdf](https://www.microtrac.com/dltmp/www/5e788a7d-9470-4131-9c88-444ec3c9c754-0afb8baf8247/microtrac_sl-an-22_d.pdf)

### Extensional and high frequency rheology

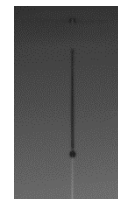
- Elongation break
- Drop formation
- Viscosity
- Elasticity



Tuladhar & Mackley, *Journal of Non-Newtonian Fluid Mechanics*, 2008

### Jetting study

- Waveform
- Frequency
- Temperature
- Drop volume
- Drop speed
- Satellites



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