Inks, Coatings, Curing and Laminating

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Agenda

- Introduction: why UV curable inks for flexible packaging?
- What are FCM (Food Contact Material) inks?
- Overall requirements of UV curable FCM inks
  - Regulatory
  - Performance
  - Economical
- One critical parameter…….
- Summary

Why print packaging in NW?

What is the typical run length / job?

Printers using wide web presses

Best for jobs > 100 000 sqm

Too expensive

Printers using Narrow web presses

Mid web ideal for jobs between 5-50 000 sqm

And here more & more packaging jobs end up

Best for jobs < 5 000 sqm

What are FCM inks?

- **Food Contact Material inks** are inks that, if correctly applied and cured and with the right choice of packaging concept, the **legal migration levels** can be met

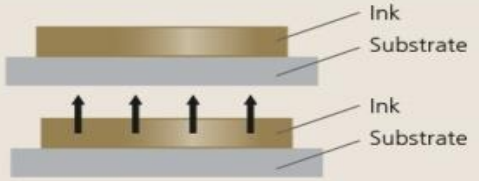
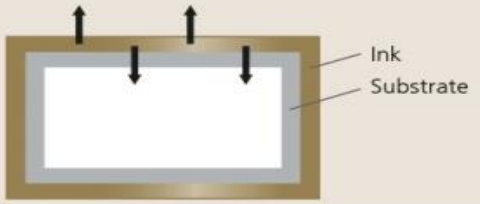
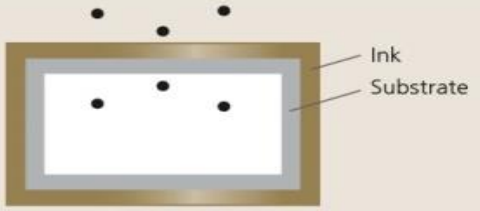
- **Legal migration limits:**
  - 60 ppb **Overall migration (OML)** for substances
  - **Specific Migration Limit (SML)** for **evaluated substances**
  - **10 ppb** for **unevaluated substances**

Overall requirements: Regulatory: what is 10ppb?

1 ppb: ~ 1 teaspoon of water in an olympic swimming pool

Overall requirements: Regulatory: Safety of food packaging

What is *migration*?

1	**Penetration Migration** Penetration through the substrate to the reverse side of the print	
2	**Set-off Migration** Set-off from the print to the reverse side while being stored in a pile ("invisible set-off")	
3	**Vapour phase Migration** Volatilisation of compounds during cooking	
4	**Condensation Extraction** Condensation of critical components when cooking/sterilisation	

Overall requirements: Regulatory: Functional barrier principle

BARRIER?

YES

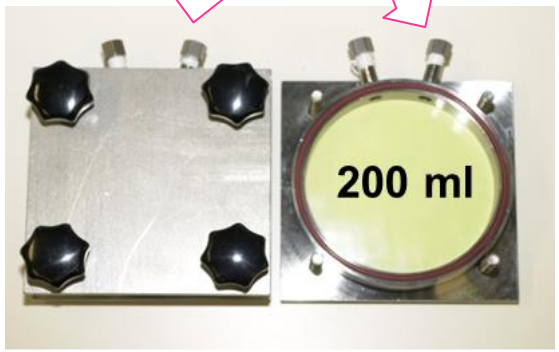
NO

Overall requirements: Regulatory: Migration testing set-up

Determination of the amount of migration from cured samples through a migration cell

1

Fill with simulating solvent



Maturi Cell

2 analytical techniques

3

2

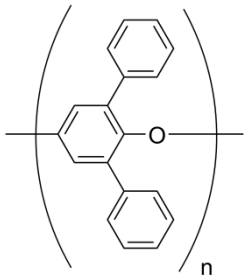
Exposure conditions:
Direct or indirect contact
Temperature: RT, 40°C, ..
Time: 1, 3 or 10 days

Overall requirements: Regulatory: Choice of the food simulant

1

Food types	Food simulants
Aqueous, non-acidic and non-alcoholic foods	10% ethanol (in water)
Alcoholic foods (< 20%)	20% ethanol (in water)
Dairy products and high-alcohol beverages (> 20%)	50% ethanol (in water)
Acidic foods (pH < 4.5)	3% acetic acid (in water)
Fatty foods	Vegetable oil (substitute: 95% ethanol (in water)
Dry/high temperature food	Tenax = poly(2,6-diphenyl-p-phenylene oxide)
UNIVERSAL SIMULANT	**95% ethanol (5% water)**

Tenax



Overall requirements: Regulatory: Choice of the exposure test conditions

2

- Indirect contact with food simulant
- Temperature: RT, 40°C, …
- Duration: 1, 3, 10 days, …

Migration testing must be conducted under the most severe conditions of temperature and time anticipated for the proposed use

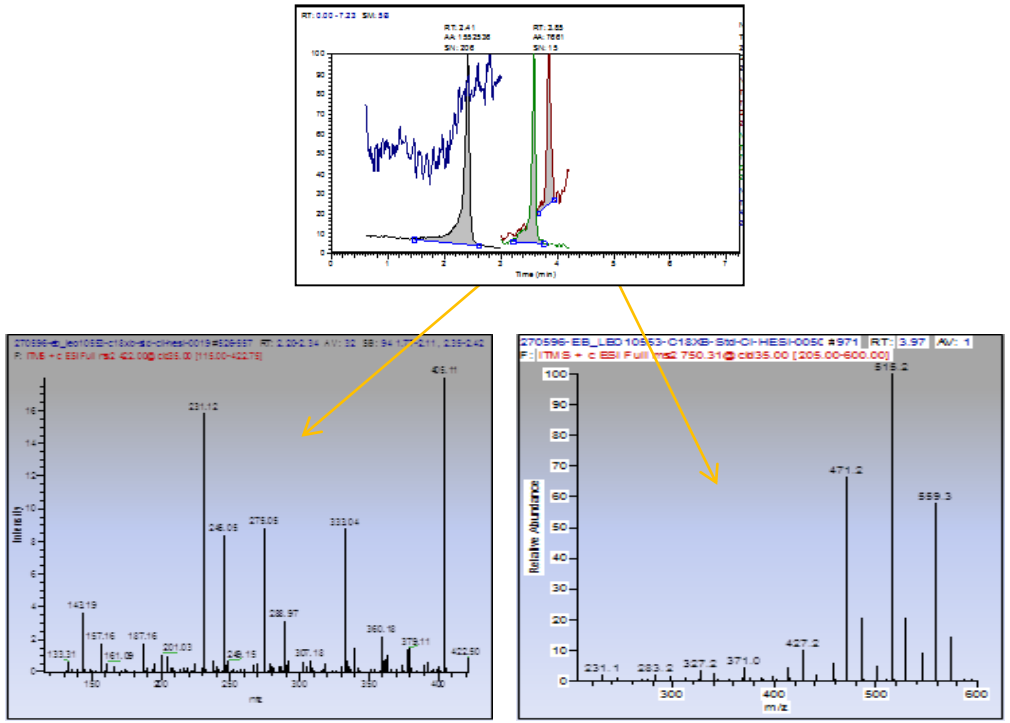
Food applications	Test temperature	Time
Room Temperature	40°C	10 days
Refrigerated or frozen	20°C	10 days
Microwave and oven	120°C	30 min to 1H

Overall requirements: Regulatory: Identification and Quantification of Migrants

3

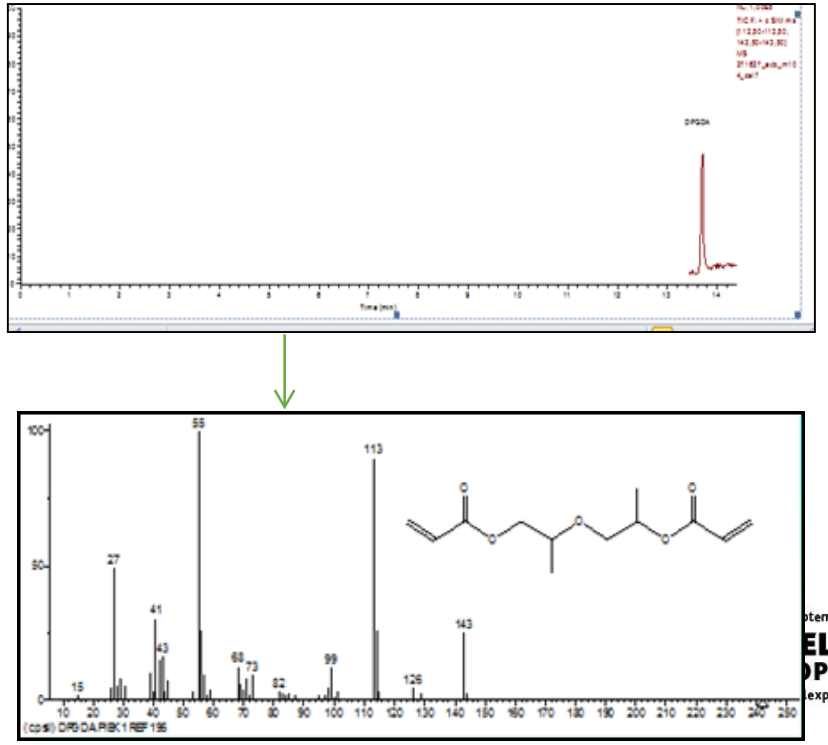
Liquid Chromatography with Mass Spectrometry (**LC-MS**)

- Both volatile and non-volatile compounds
- Identification of migrants in food simulant
- Quantification of **low and High Mw ingredients** (Mw < 2500 Daltons)



Gas Chromatography with a Mass Spectrometry detector (**GC-MS**)

- Volatile and many organic-soluble analytes
- Identification of migrants in food simulant
- Quantification of **low Mw ingredients** (Mw < 500 Daltons)



Overall requirements: Regulatory Landscape

- **No Specific European harmonized legislation for inks but several legislative instruments which impacts materials and articles for food**
- Some examples in EU:
  - **Regulation EC 1935/2004**
  - **Regulation EC 2023/2006: rules on GMP**
  - **Directive 10/2011 (Plastic Regulation)**
- **Swiss ordinance** is the first specific and complete legislation on printing inks
- **Nestlé Guidance Note** on packaging inks

Development of FCM inks

Development at different levels

RAW MATERIAL SELECTION

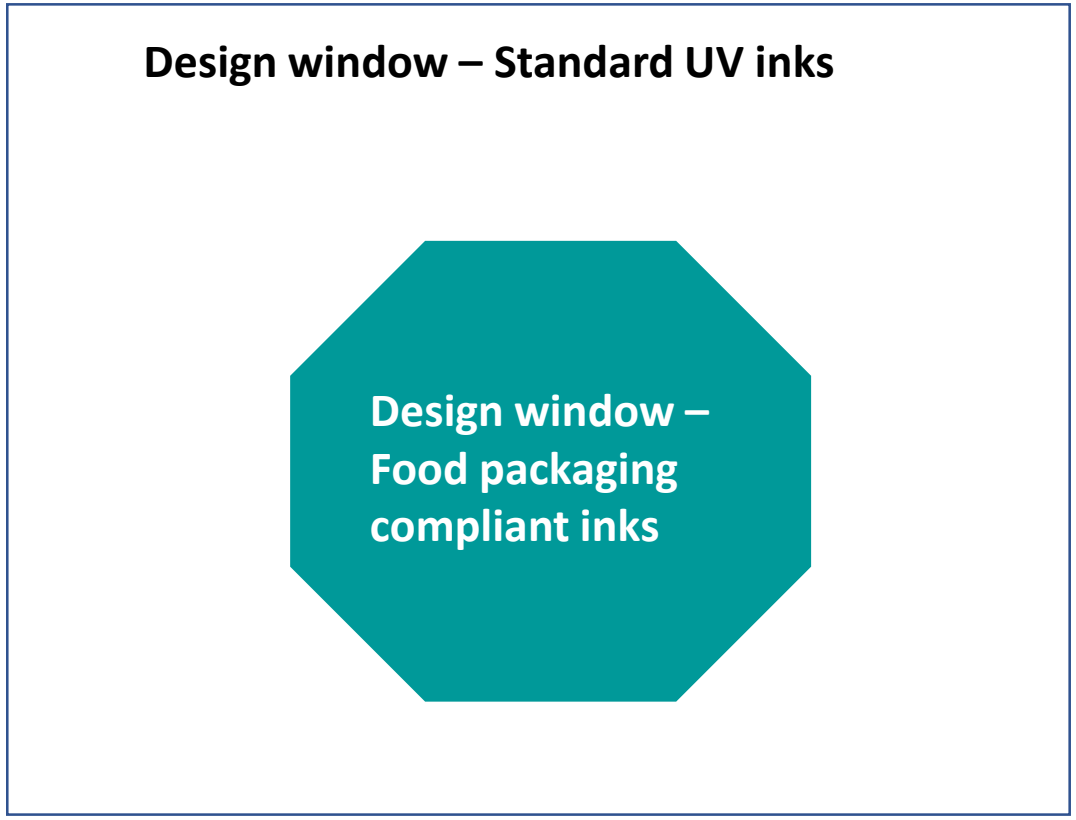
ADAPTED PROCESS

GMP

GOOD MANUFACTURING PRACTICES

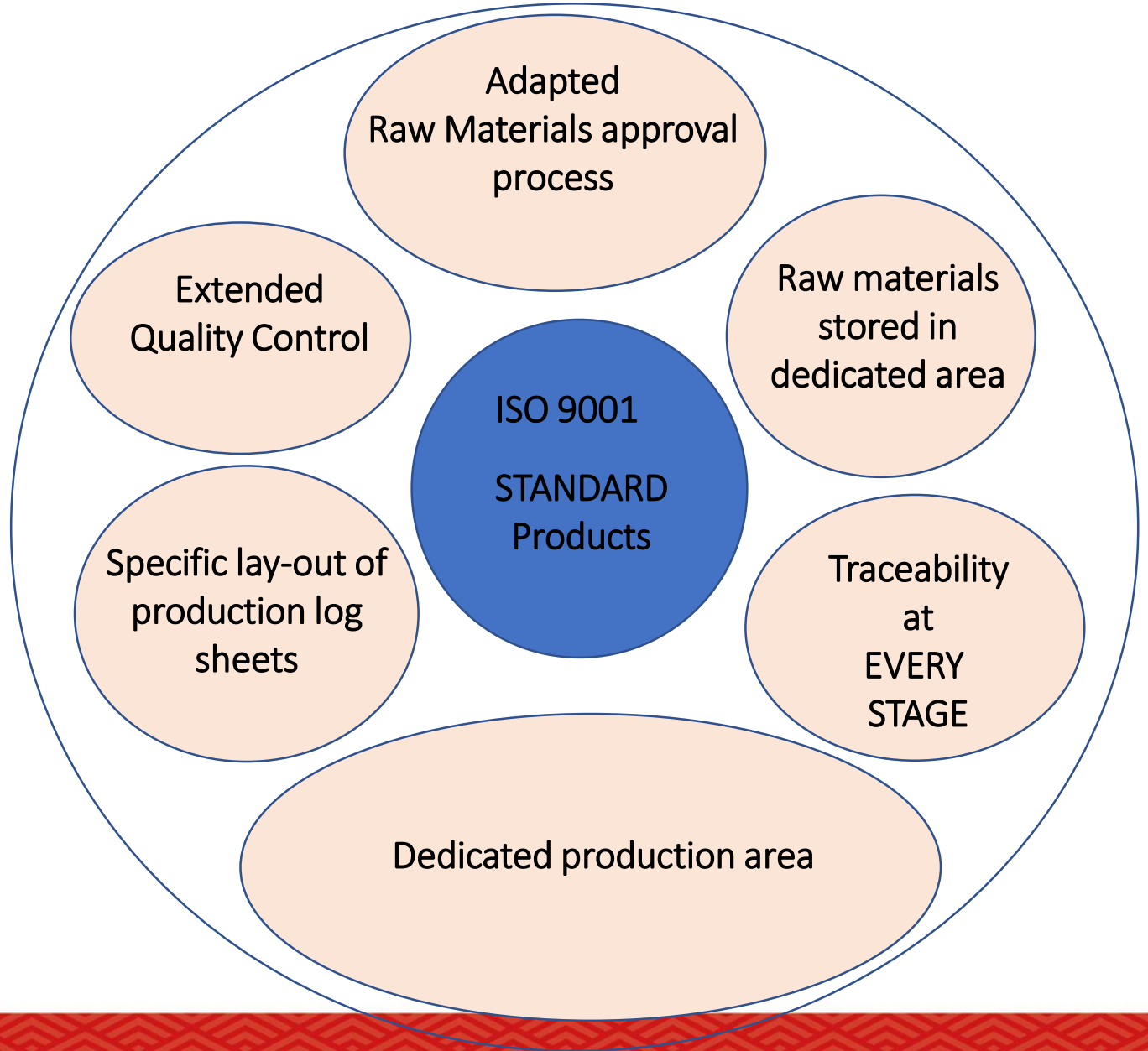
Raw materials: Designing FCM inks

- Less building blocks available
- Excluding low molecular weight monomers prone to migrate
- High colour strength
- Legislations and regulatory environment continuously moving
- Increased awareness among local brand owners
- Fit-for-purpose



Targeting a design window that gets smaller every year

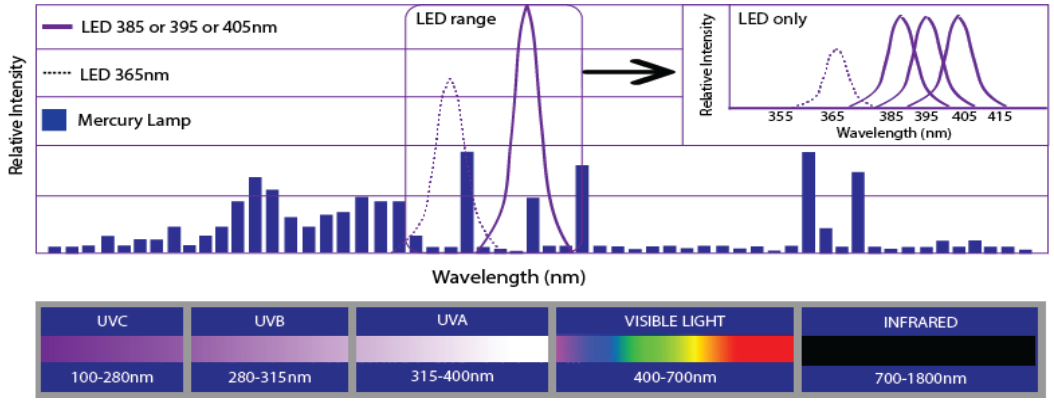
GMP: Good Manufacturing Practices



One critical parameter: UV curing

- Why is UV curing so critical in FCM applications?
  - Without proper curing there will be:
    - Less good scratch and solvent resistance
    - ***Higher risk of migration (demonstrated by facts)***

- How to ***ensure proper curing***?
  - Monitor printing speed
  - Monitor chill roller temperatures
  - Monitor ink thickness
  - Check UV lamp intensity and UV lamp life time
  - Check UV lamp reflectors



- 2 types of UV light sources: UV Hg and UV LED
  - The wavelength and light intensity dictate the chemistry
  - Conventional UV inks will NOT cure adequately with UV LED lamps
- What do you need to know about UV LED:
  - Lamp Supplier, Wavelength – 395 nanometer, 385 nm
  - Irradiance Output (e.g. 16 Watt/cm^2)
  - Distance lamp to web (typical 3-5 mm)
  - Effect of chill roll temp
  - Angle of lamp to web
  - Press speed

Check all parameters that could influence curing
Document print job conditions (including UV lamps settings)

Summary

Collaboration throughout the whole value chain !