Barrier Solutions in Injection Moulded Containers for Food Packaging

Injection Moulding Forum 13.-14.4.2011

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Innovation through Insight

Topics of the day

- Norner Innovation – brief company introduction
- Consumer trend supporting barrier development
- Competitive environment in food packaging
- Applicable oxygen barrier technologies for IM containers
- Oxygen barrier calculation model

Norner is…

- Plastics and polymer institute
- International innovation company
- Clients through the plastic value chain

>60 Scientists, polymer technologists, end user specialists, lab and conversion engineers. International innovation projects

4000m² Scientific Laboratories

- Our vision

Innovation through Insight

Plastics development and support

- International plastics and polymer institute
- Projects for plastics manufacturers, converters and brand owners
- Wide international network in polymer technology and applications

- Innovation projects
- Technical studies
- Consulting
- Troubleshooting

- Partner for development and technical support

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Norner key competencies

Plastics, processing, products and packaging

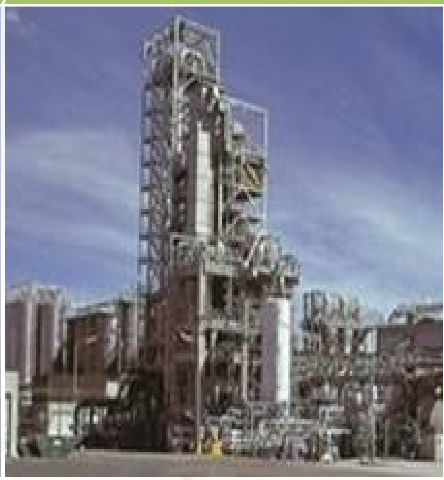
Additives, chemicals, REACH and compounding

Polymers, Catalysts, Gas, Polymerisation and Process

Advanced Laboratories

Our core competence -The Plastic Market & Value Chain

Upstream Oil & Gas	Plastic Production	Conversion to Products	End Use - You and I

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Processing lines

2 Blow Moulders

5 Injection Moulders

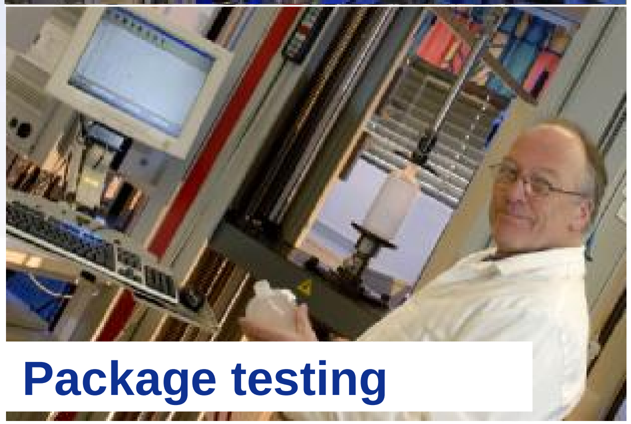
3 Blown film lines + MDO

1 Rotomoulder

Examples from our facilities


Polymerisation


Microscopy


Package testing


Food contact

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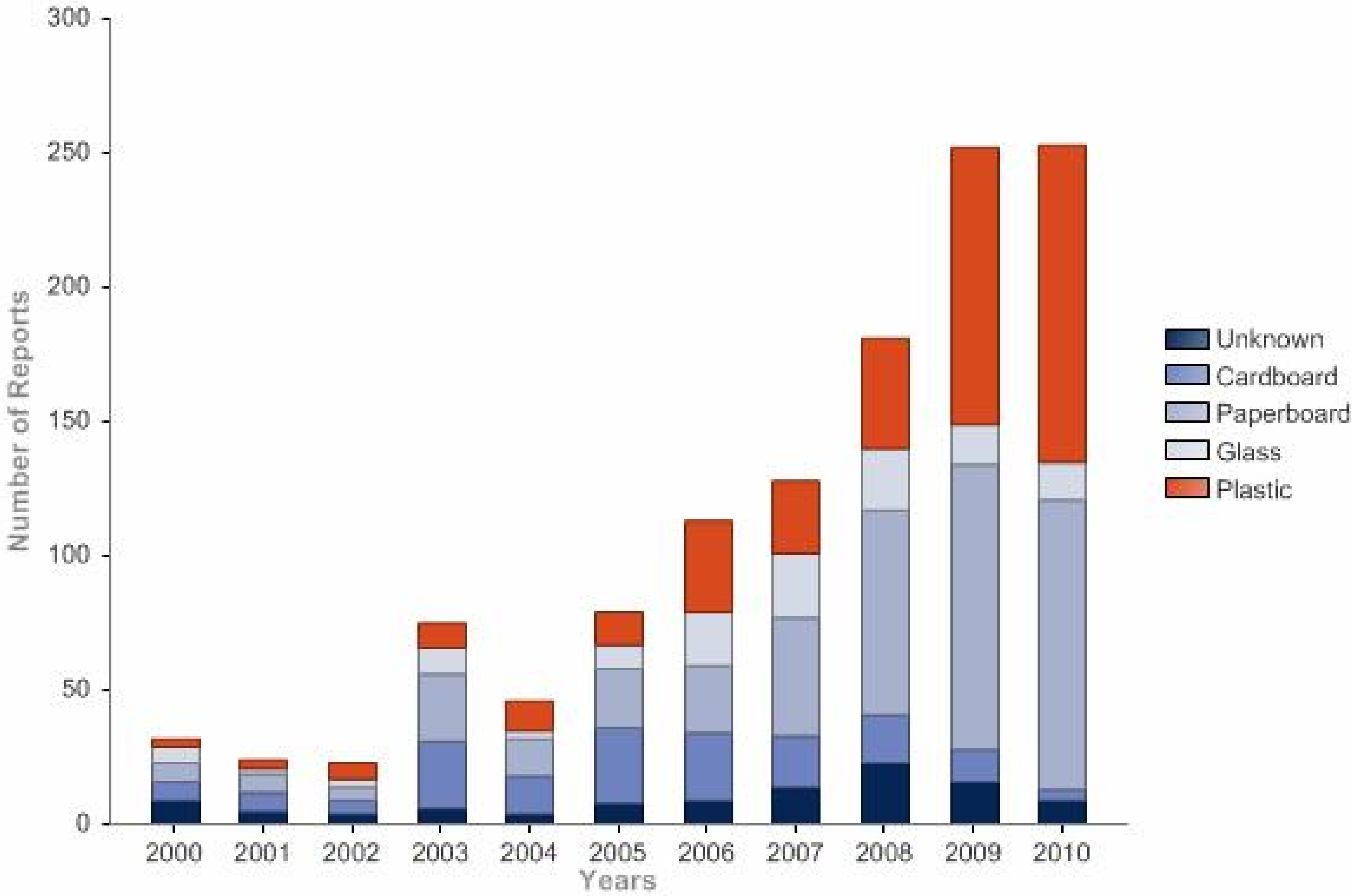
Consumer and market trends	Food packaging requirements
Single household More working women Cash rich (relatively); time poor consumers	Ready made meals & convenience food in innovative packaging Portion control, smaller portion packages
Health awareness	Less preservatives, higher barrier requirement for package
Environmental awareness	Weight reduction of packaging material Energy efficient transport Space and weight savings Reduction of food waste by longer shelf life
Differentiation	Shelf appeal, modern expression Injection moulding freedom of design,

O_2 barrier	✓✓✓	✓✓✓	✓✓
H_20 barrier	✓✓✓	✓✓✓	✓✓✓
Design freedom	✓	✓	✓✓✓
Safety	—	—	✓✓✓
Weight	—	—	✓✓✓
Image	✓✓✓	✓✓	✓[✓]

Product launches of baby food by packaging material (France,Germany,UK,Spain, Italy)



Source: Data monitor consumer insights

NaturNes –Baby Food Innovation

Source: www.nestle.com

NaturNes –Baby Food Innovation

“NaturNes is a baby food made from **100% natural ingredients**. The recipes have been created to meet the **highest nutritional standards** and to ensure that the food tastes great. A novel steam cooking technology was developed to preserve these qualities.

The packaging was also **redesigned taking into consideration both the consumer and the environment.**

Source: www.nestle.com

NaturNes –Baby Food Innovation

Modern, convenient packaging

The pack features light and stackable plastic bowls with re-closable lids for freshness. The design reflects **consumer convenience and safety**. Parents can hold the plastic bowl in their hand when feeding their baby; it has a solid base so it does not tip when children start to feed themselves.

Packaging with reduced environmental impact

Using **Life Cycle Analysis** of environmental impacts across the lifecycle of its products, Nestlé works to improve the environmental performance of its products. For *NaturNes* baby food, **lightweight plastic bowl packaging has been selected over traditional glass jars to help deliver a 25% reduction in C02 emissions and energy consumption in production and transportation**

Source: www.nestle.com

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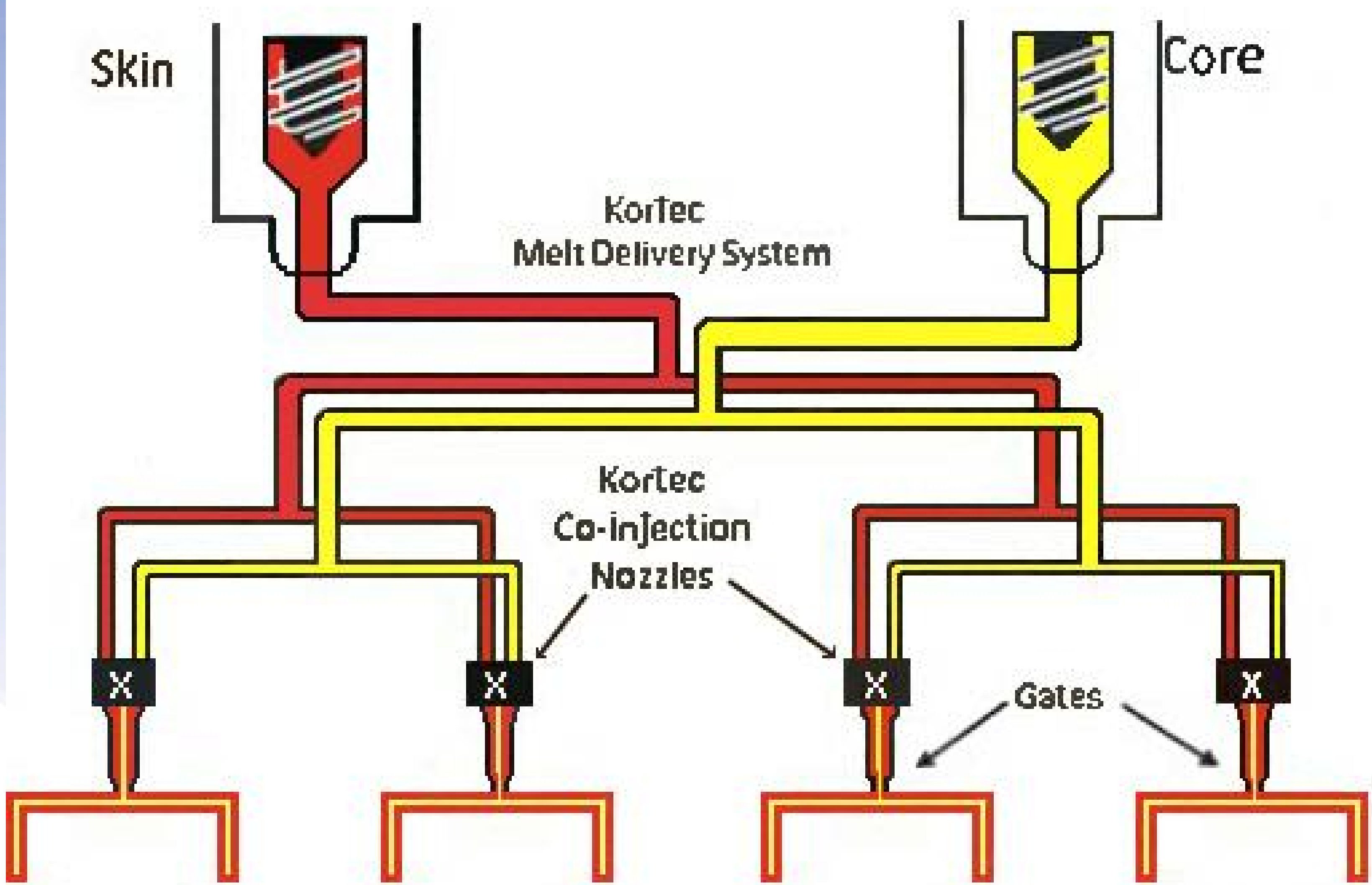
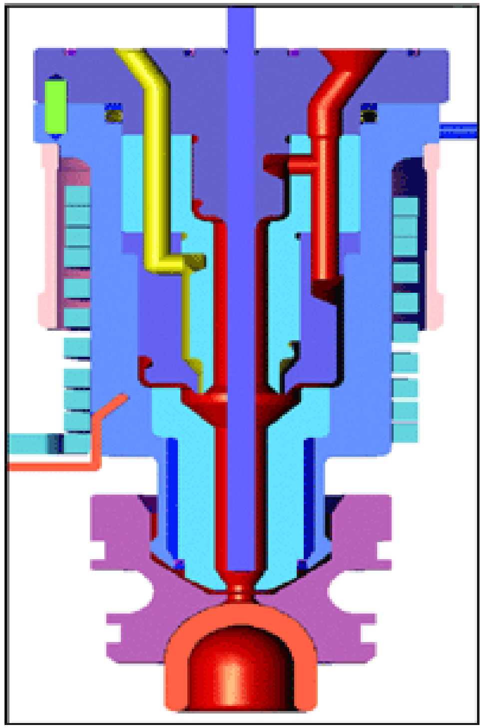
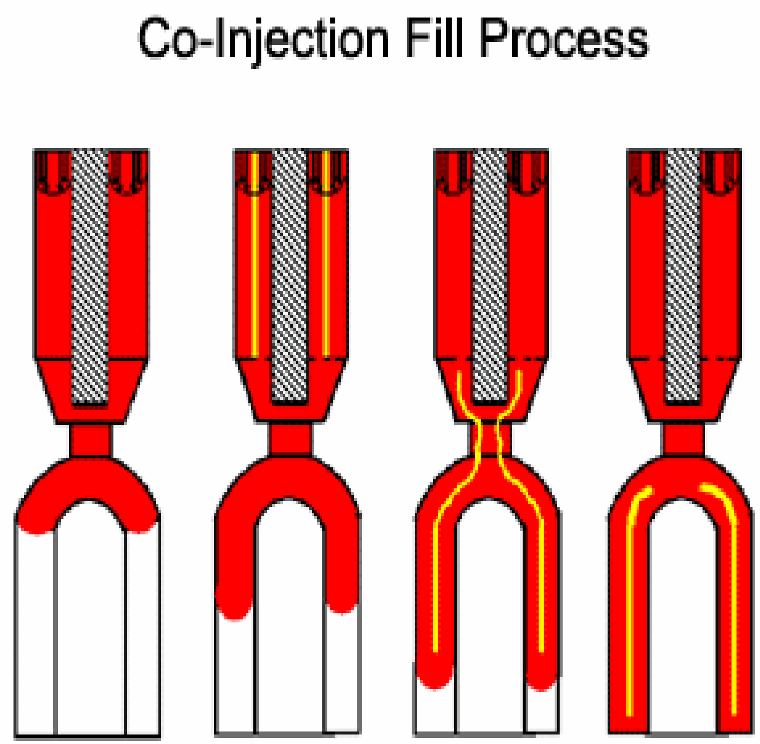
- 2K injection with EVOH barrier layer
- In mould labelling with barrier label
- Coating



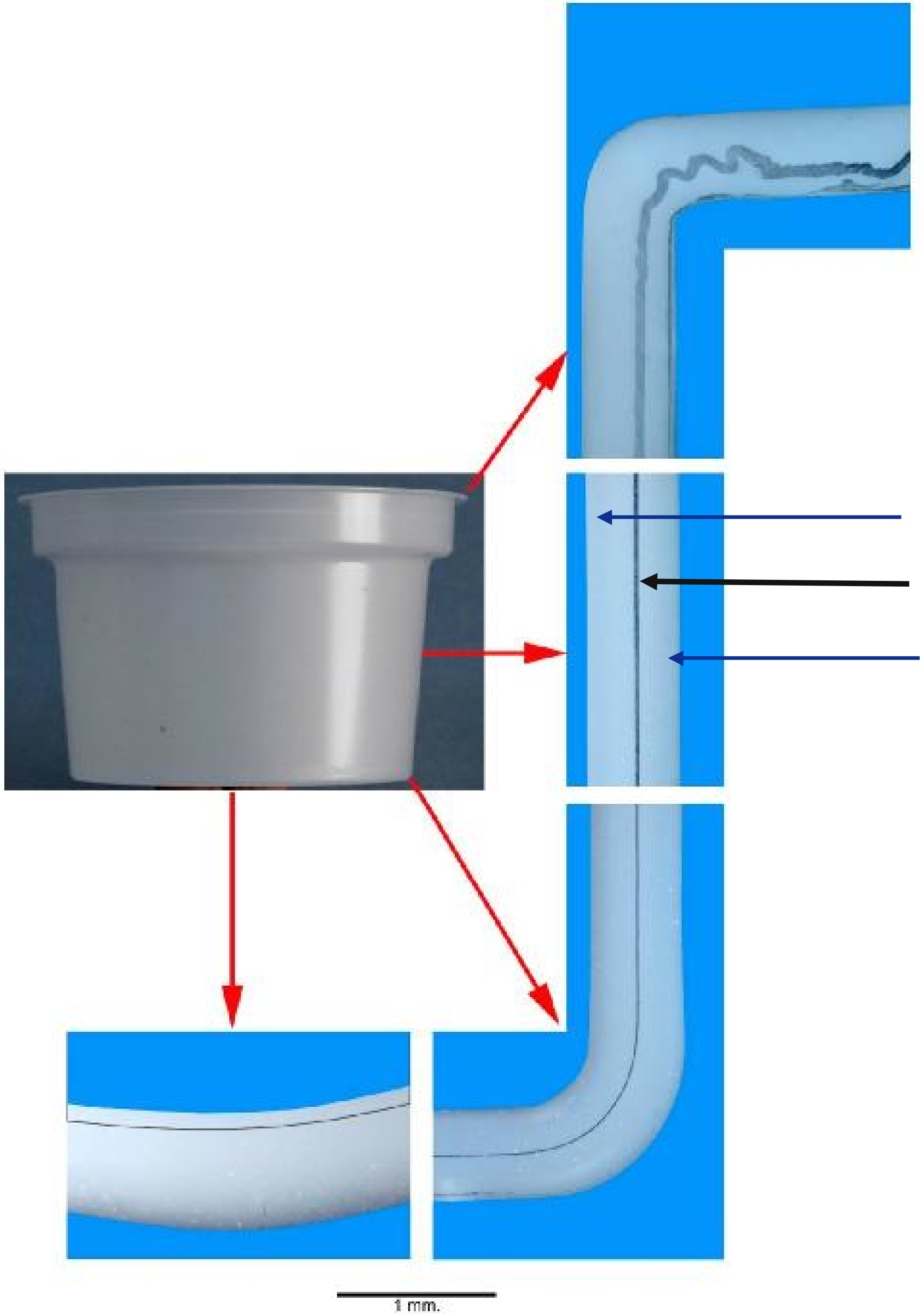
Source: www.kortec.com

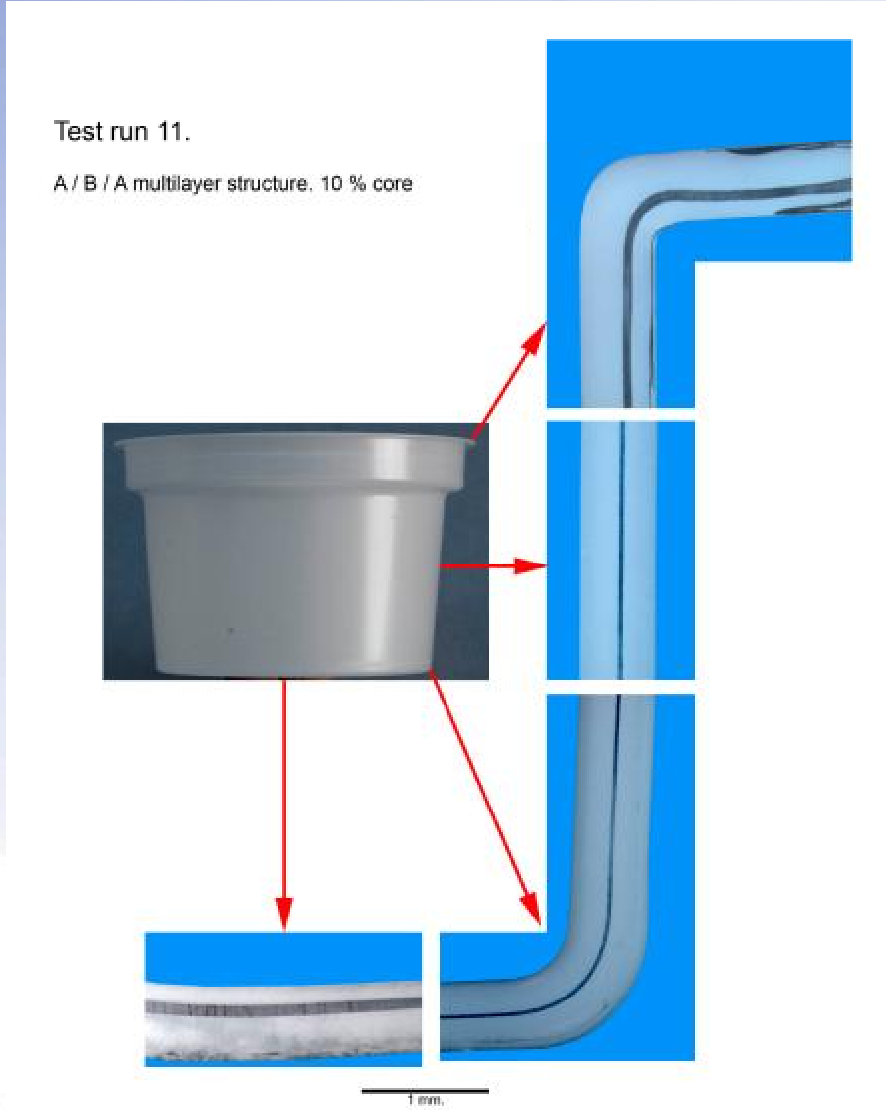
2K Technology: co-injection nozzle and filling



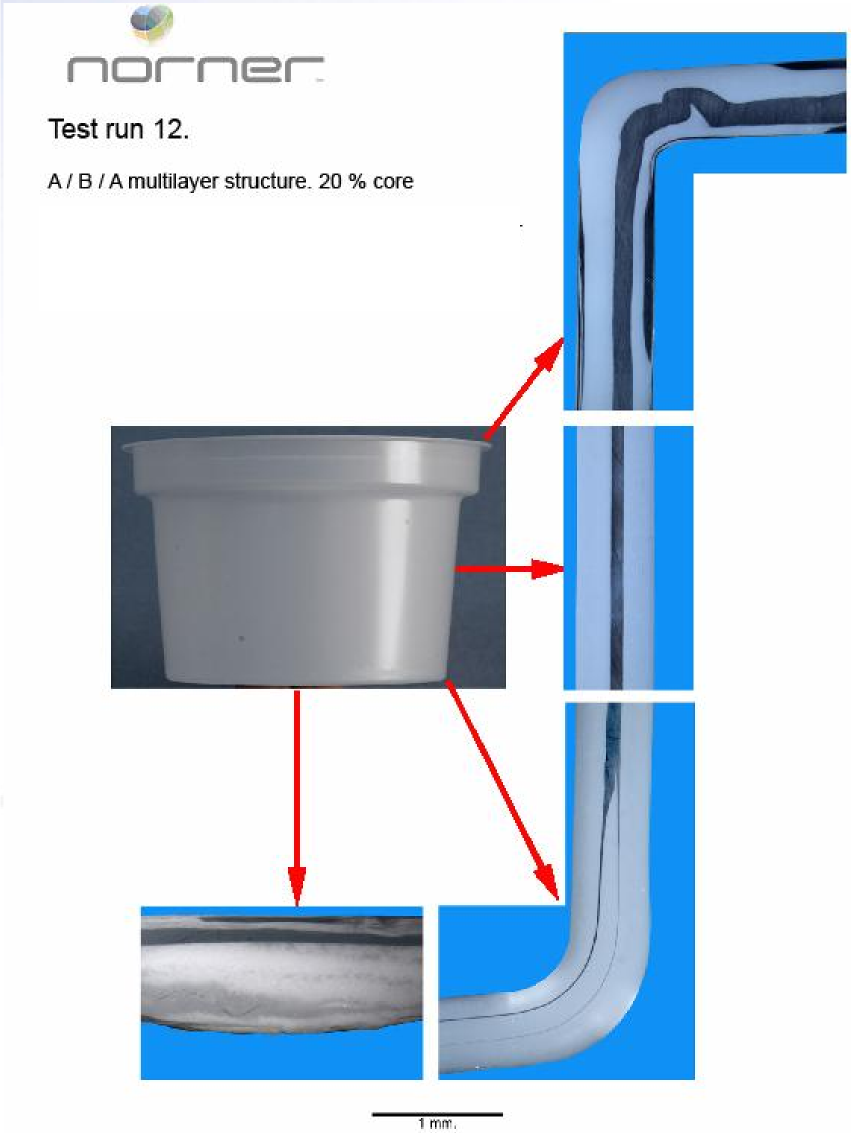


Source: www.kortec.com


Skin : Polypropylene
Core : EVOH
Skin : Polypropylene
1 mm.



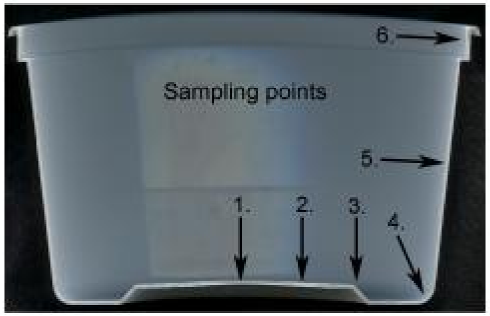
Thickness bottom 90 µm, corner 30 µm, sidewall 30 µm, top 65 µm

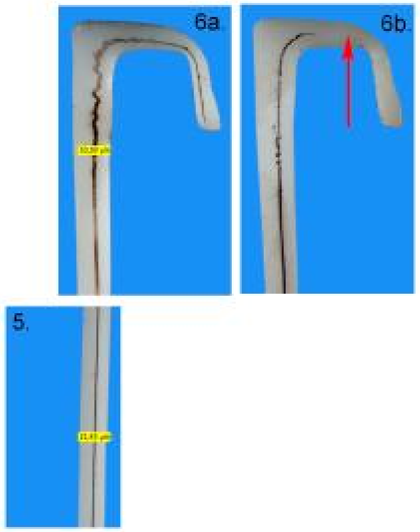


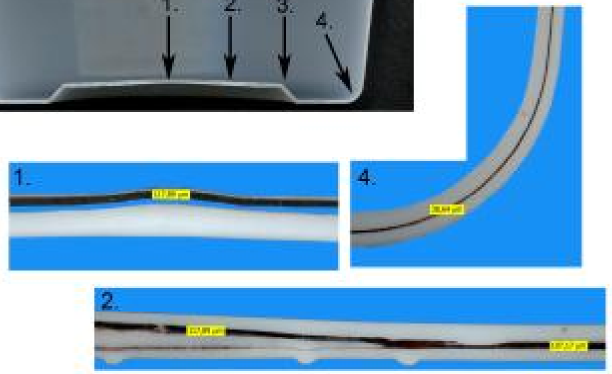
Thickness bottom 100 **µm, corner 15 µm, sidewall 95 µm, top 140 µm**

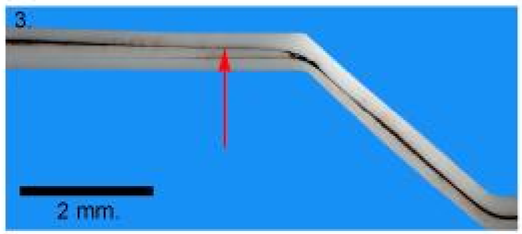
PP / EVOH / PP container

0,5 liter









Comments:
The barrier layer (EVOH) is continuously in the cup from the cavity 1 and 2.
In some areas, the barrier layer is very thin < 20 µm. (sampling point 3).
The microscopy investigation reveals that the barrier layer is not continuously in the top edge (image 6b.) There is no significant difference in the layer structure in cups from cavity 1 and 2 or from different sampling points around the cups.
The microscopy investigation shows a delamination between the skin layers (PP) and barrier layer (EVOH) in and nearby the inlet point.

TR:81500 Kristen Kjeldsen \ Norner as \ SL \ 10.02.11. \ Page 1.

Oxygen Transmission Rate - Theoretical vs measured

- Wall thickness total 0.6mm; EVOH layer 20µm
- Top radius 5.7cm; Bottom radius 4.5cm; Height 6.8cm

- Oxygen Transmission calculation model gives (RT, 50%RH)
    - 0.002 ml/(package·day)

- Measured Oxygen Transmission rate at RT /50% RH for the cups
    - 0,006 ml/(package·day)
    - 0,006 ml/(package·day)
    - 0,007 ml/(package·day)

Status thin wall turnkey systems available from Kortec

- Single face: 8,16,24,32 & 48 cavity systems
- Stack mould:2x4, 2x8, 2x16, 2x24, 2x32 cavity systems
- Platform: 200 ton - 1000 ton two shot IM machines

- First commercial production machineries installed and under commissioning (1000 ton, 32 cavity)

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Key requirements for IML film

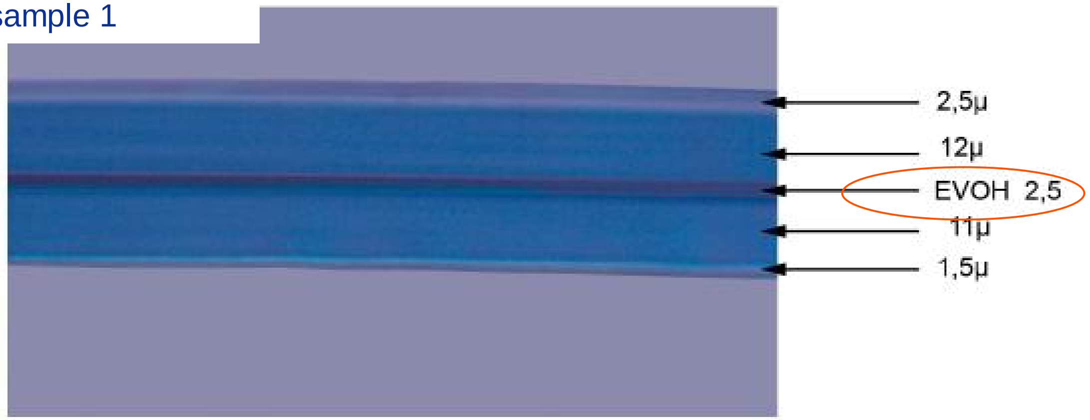
- Right mechanical and surface properties for a smooth and high quality printing process
- Anti-static properties
- Excellent lay-flat properties

Standard decoration IML films and technology well established

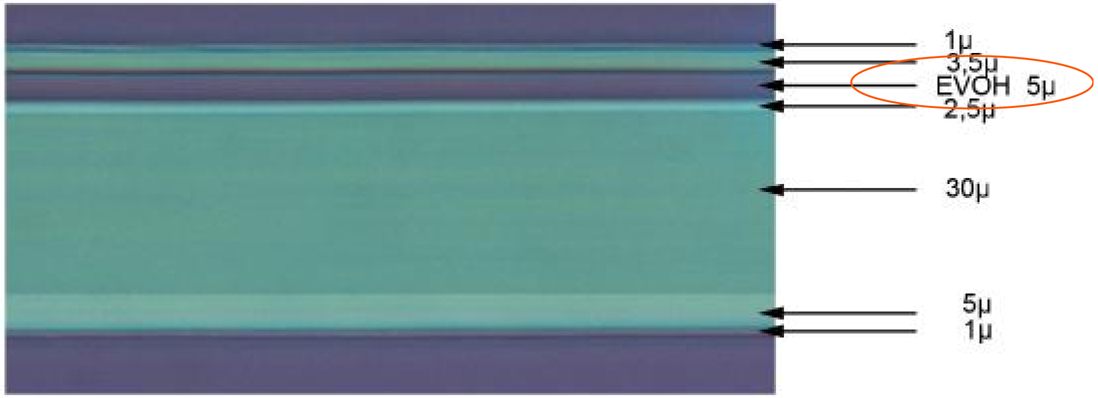
Challenges in barrier IML :

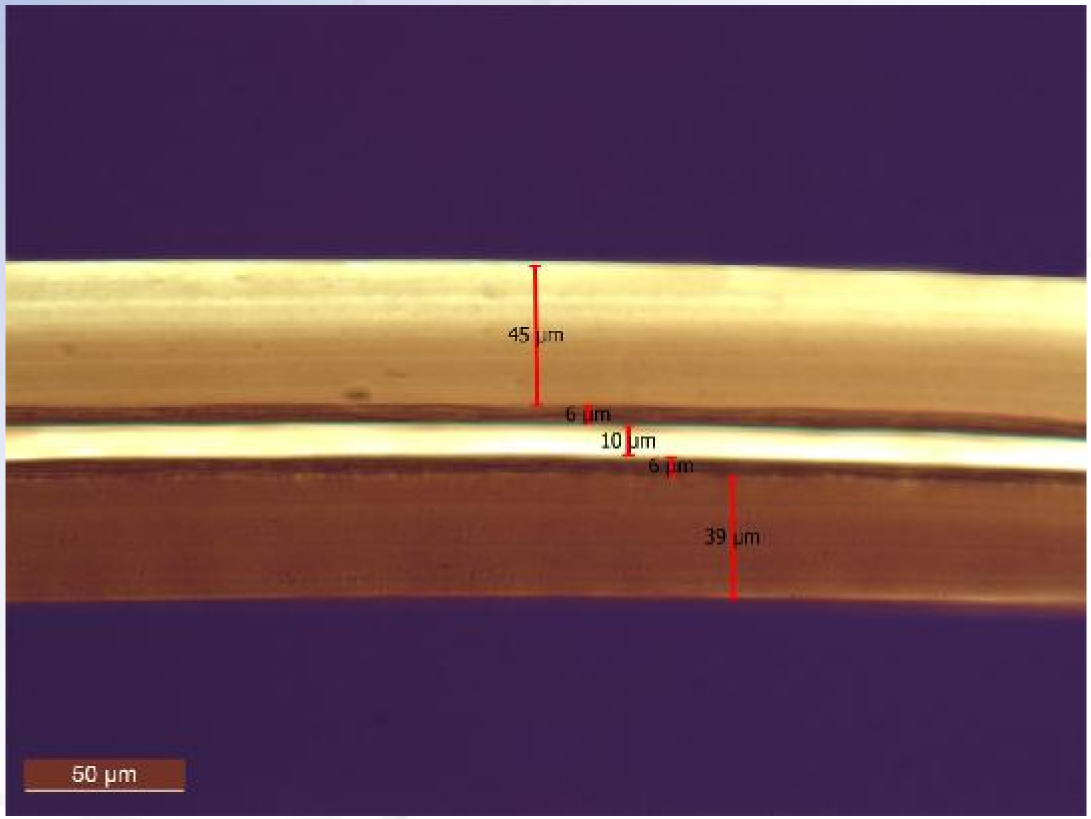
- Introducing barrier layer to IML film without loss in other key properties
- Wrap around & bottom label with overlap of all label seams (100% coverage), extreme accuracy required.

Barrier IML
sample 1



Barrier IML
sample 2





PP

Adhesive layer

EVOH barrier layer

Adhesive layer

PP

Barrier IML containers launched

"A plastic container with excellent barrier protection for long shelf life. A see through area and a great design without the risk of breakage. This was what French Lesieur was looking for - and found in SuperLock."

www.Superfos.com

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Plasmax coating tehcnology by KHS

- Plasma impulse chemical vapour deposition (PICVD) process
  - A vacuum chambers is loaded with bottles
  - A vacuum is then applied and a reaction-gas mixture is introduced that transforms the gas into an energy-rich plasma state
- Coat the interior bottle surface with an extremely thin 10 -100 nanometer silicone oxide (SiOx) transparent , impermeable layer
- Silicon oxide (SiOx) layer provides the PET bottle almost the good barrier characteristics of a glass bottle.

www.khs.com

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New barrier coatings for containers

(Plastics Technology, issue April 2011)

- Cavonic 3D Coating Technologies brings a new barrier coating technology to processors of rigid containers
- Cavonic eco-shield uses plasma-enhanced chemical vapor deposition and physical vapor deposition technologies to add an impermeable barrier coating to molded or thermoformed containers.
- Customized coatings reportedly can be applied to virtually any type of substrate, including PE, PP, PET, PS, and PLA and are also compatible with a wide range of container shapes.
- Cavonic based in Germany offers a complete system including automation, vacuum chambers, and coating chamber integrated in-line with the processing operation.

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Oxygen Transmission Rate Calculator

Norner is an international, industrial and technology partner for Plastic and Material Industries.

OTR Calculator

This simulation model estimates the oxygen transmission rate of plastics packaging material like PP, PET and EVOH. Barrier properties of co-injection multilayer and in-mould -label solutions can be studied and evaluated.

The combination of geometrical options, permeability properties and environmental conditions provides an useful tool when working with the design, development and application of plastic packaging.

Simulation tool

Film	Cup (Frustum)
Cuboid	Bottle

Calculation steps

1. Define geometry parameters (e.g length, radius, height).
2. Choose materials (define layer material and thickness).
3. Define environmental conditions (temperature, humidity).
4. Push calculate.
5. View and evaluate calculation results.

We can offer

- This model focuses on OTR simulation of multilayer barrier film, multilayer containers and barrier in-mould label containers.
- Norner AS is involved in several development projects involving other barrier

About the calculator

- Assumptions and limitations
- Disclaimer

Contact us

Morten Augestad, Mobile:+47 91589709

OTR Calculator

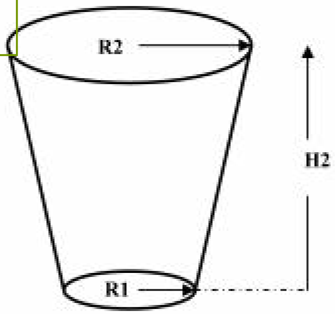
- Additive testing
- Automotive testing
- Failure analysis
- Packaging Industry
- Pipe testing
- Protective coating

Cup (Frustum)

1. Input: geometry and dimensions

Geometry

Radius 1 5 cm
Radius 2 6 cm
Height 11 cm



Layers

2. Input: Material and wall thickness

	Material	Permeability [(ml·mm)/(m^2·atm·day)]	Thickness [µm]	
1	PP		1200	
2	EVOH 32%			
3	PP			

Add layer

IML layers

3. Input: IML materials, layer thickness and label coverage

	Material	Permeability [(ml·mm)/(m^2·atm·day)]	Thickness [µm]	
1	PP		35	
2	EVOH 32%		5	
3	PP		35	

Add layer

Label coverage (of area without top) 100 %

Test conditions

4. Input: Conditions

Time 1 days
Temperature 20 °C

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Layers

	Material	Permeability [(ml·mm)/(m²·atm·day)]	Thickness [µm]
1	PP		1200
2	EVOH 32%		
3	PP		

Add layer

IML layers

	Material	Permeability [(ml·mm)/(m²·atm·day)]	Thickness [µm]
1	PP		35
2	EVOH 32%		5
3	PP		35

Add layer

Label coverage (of area without top) 100 %

Test conditions

Time	1	days
Temperature	20	°C
Rel. humidity	50	%
Oxygen level	20.9	%

Calculate

Results

Total thickness	*L*	1.275	mm
Permeability, overall	*P*	1.747	(ml·mm)/(m²·atm·day)
Area (excluded top)	*A*	0.046	m²
Volume, container	*V*	1.048	l
Volume, oxygen	*q*	0.013	ml
Oxygen transmission rate	*OTR*	0.013	ml/(package·day)
Oxygen transmission rate	*OTR*	0.286	ml/(m²·day)

Conclusion

- Consumer trends represent a strong need for an efficient barrier solution in thin wall injection moulding
- Technology development by machine suppliers can be met by material development and give a strong solution.
- Specific 2K multilayer IM technology, barrier IML and coating solutions can be expected to drive strong progress in further substituing glass and metal as well as thermoformed plastics containers.

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