Recent Trends & Industry Challenges in Coated Paper & Board market

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Polymer Dispersions Paper Coatings
Asia Pacific

Agenda

- Market Requirements and trends in Coated Paper Industry
- BASF Innovation strategy activities
- Innovation solutions to address market needs:
  - ✓ High Solids Coating Technology
  - ✓ New Range of Binders of low VOC and GB 9685 compliance – food contact grades
    - ❑ Styronal ® ES grades
    - ❑ Basonal ® FCB grades
- Future path and recommendation

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BASF innovation activities address trends, market drivers & Industry Challenges

Latex Suppliers → Paper mill → Printers Converters → Brand owner → End consumer

Industry Challenges

Paper mill:
1) Printability
2) Convertibility
3) Sustainability
4) Runnability
5) Cost In Use

Brand owner:
1) Sustainability
2) Cost Reduction
3) Properties Consistency

BASF Solutions

Continuous stream of Innovation

R&D Focus towards the key Industry Challenges

- Binders with Sustainability & Compliance
- New Range of Low VOC & Odor Binders
- Food Contact & Liquid Packaging Board
- High Performance Rheology Modifiers
- High Performance Binders technology

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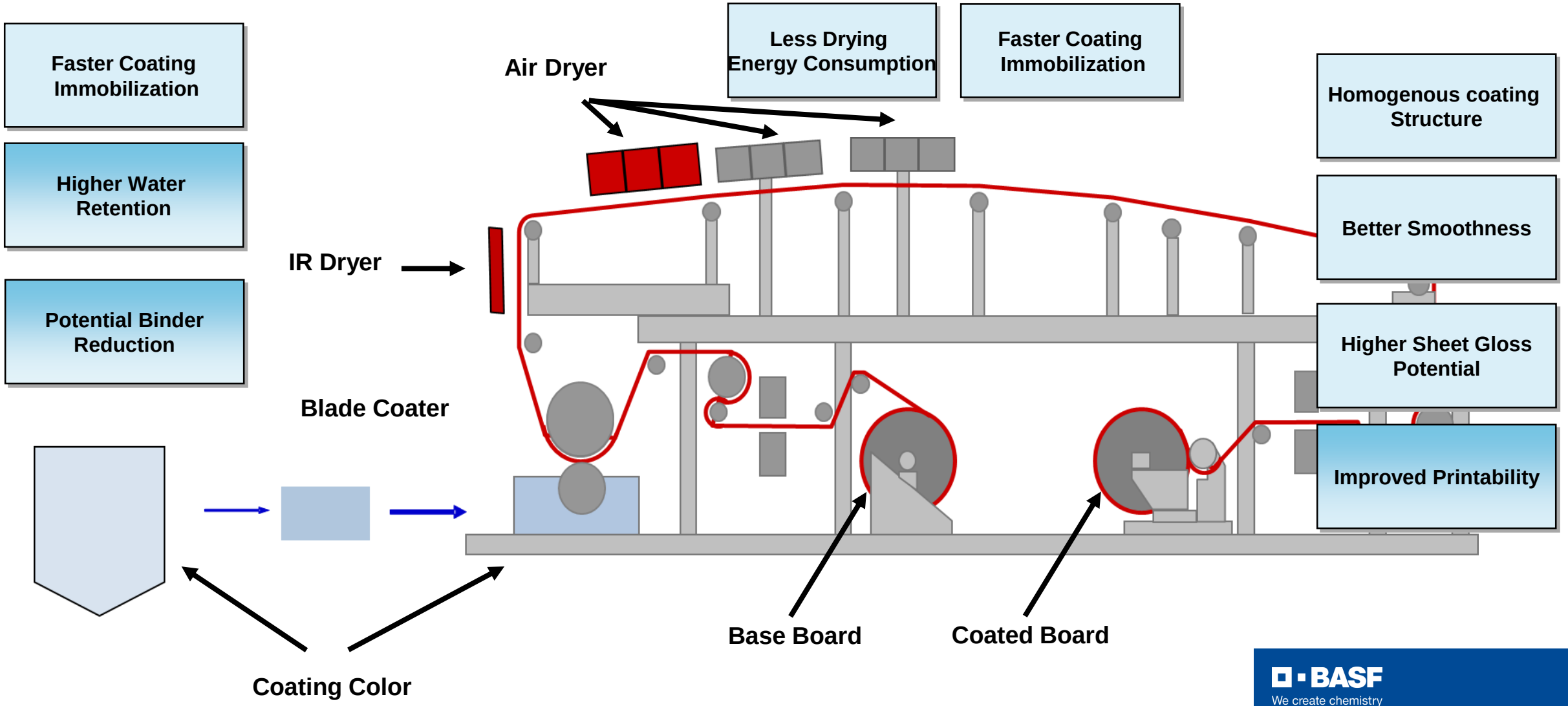
Value Proposition –Performance Benefits



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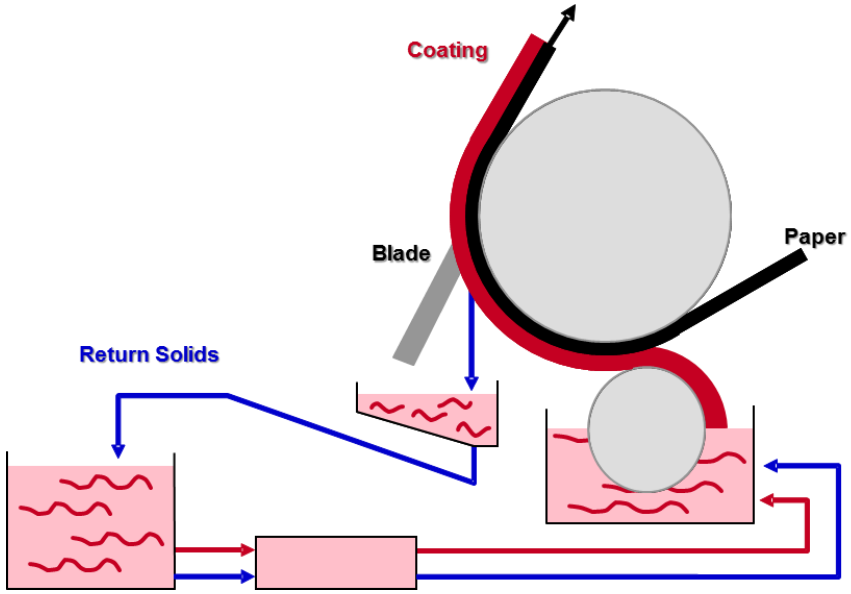
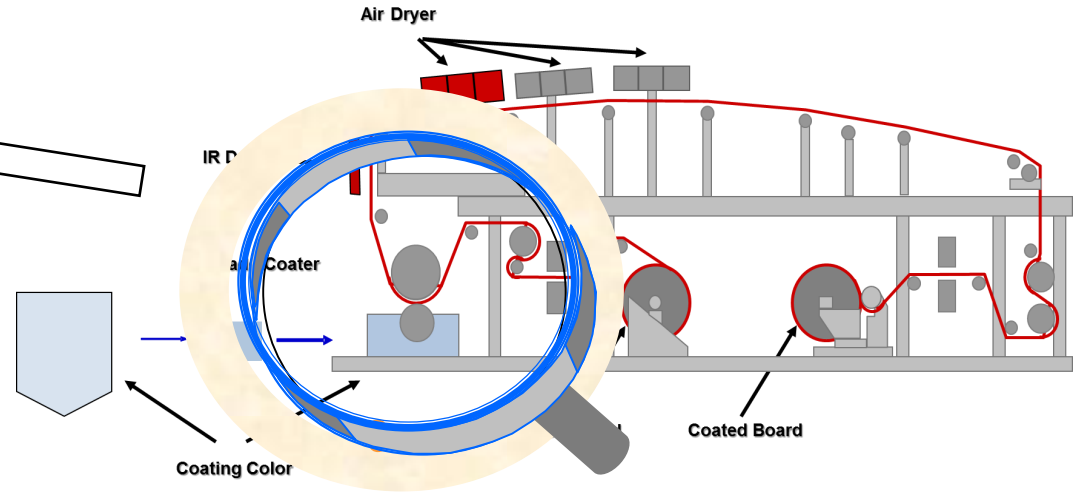
Value Proposition –Performance Benefits
Coater Runnability

- **Ability to run high coating solids**
- **Faster Coating Immobilization**
- **Potential reduction in Binder Usage**





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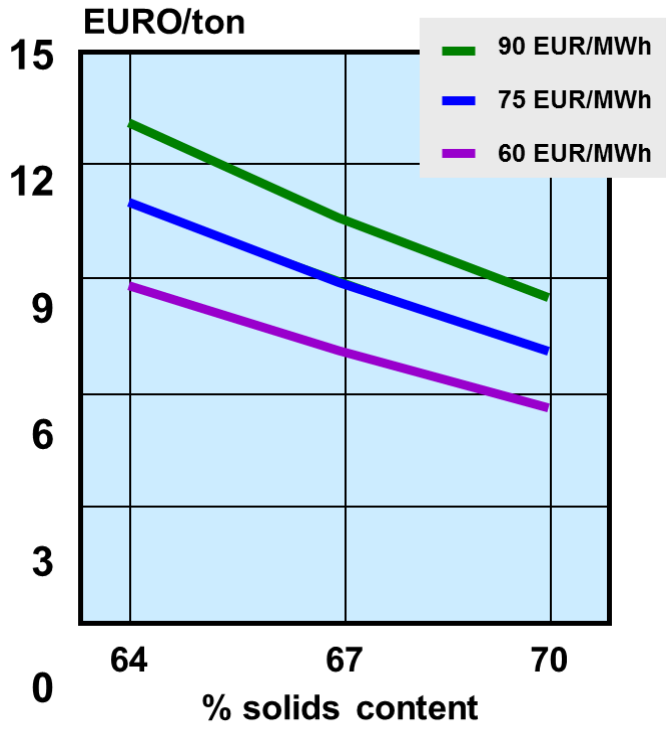
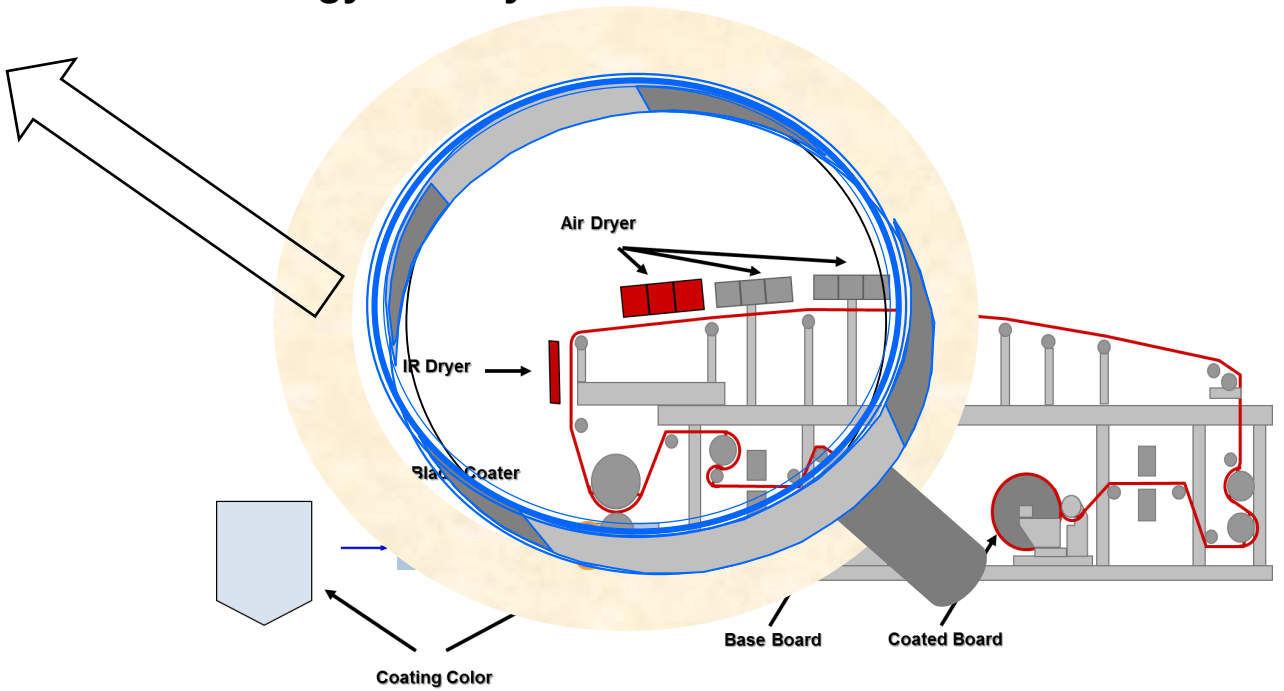
Value Proposition –Performance Benefits
Improved Drying Efficiency – post coating

- **Higher Coating Solids Formulation**
- **Reduced water in coated Paper**
- **Better Post Coating Drying Efficiency**
- **Increase in Coating Make Down Solids from 64% to 70% reduces energy cost by 25%**





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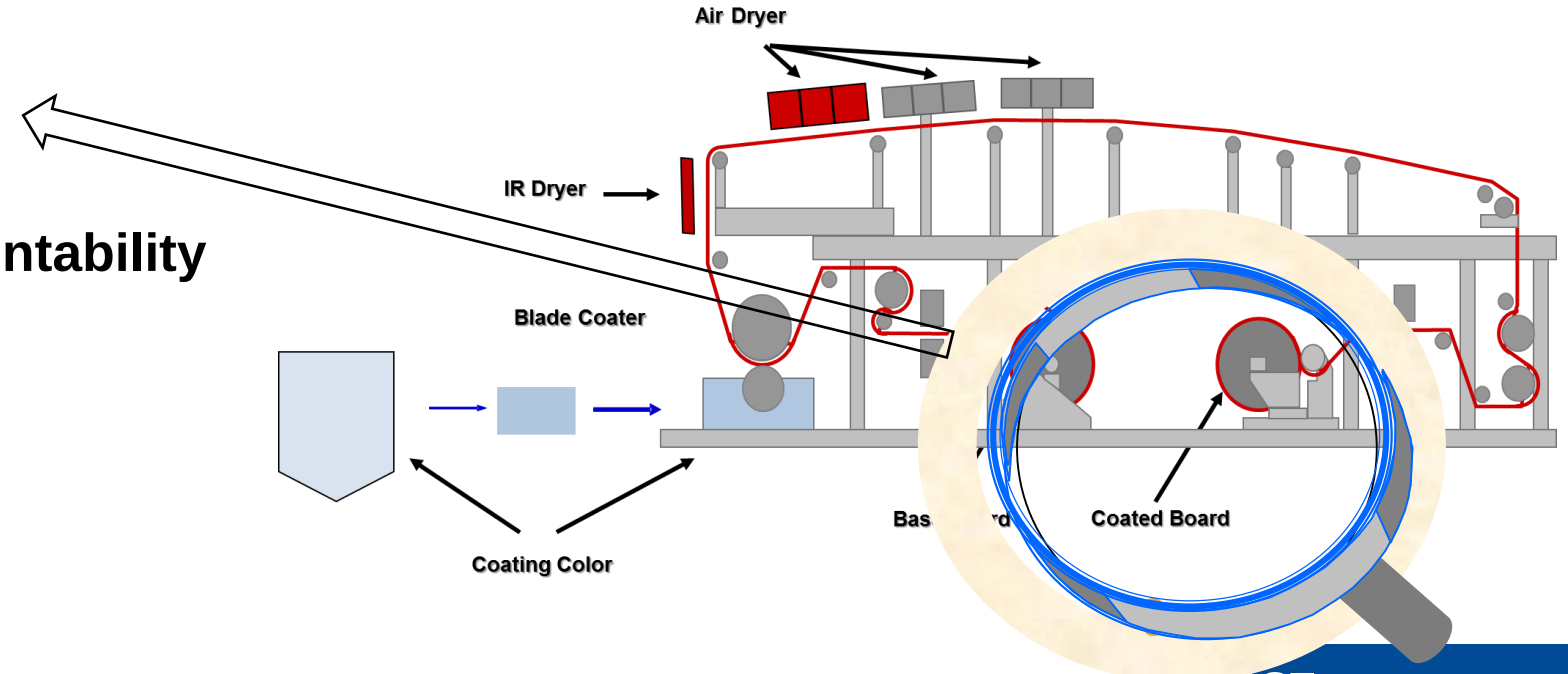
Value Proposition –Performance Benefits

Improved Coated Board properties

- **Improved Coverage**
- **Better Smoothness**
- **Better Sheet Gloss**
- **Excellent Offset & Gravure Printability**



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Challenges in Attaining High Coating Color Solids

- **Optimized recipe needed to have smooth coater runability**
  - Coating Rheology
- **Coating Ingredients solids**
  - Carbonate at maximum 75% solids
  - Clay dispersed at maximum 70%
  - Other additives approx. 20% solids
  - Suitable Coating Rheology modifiers are required
  - Regular Latex at 50% solids

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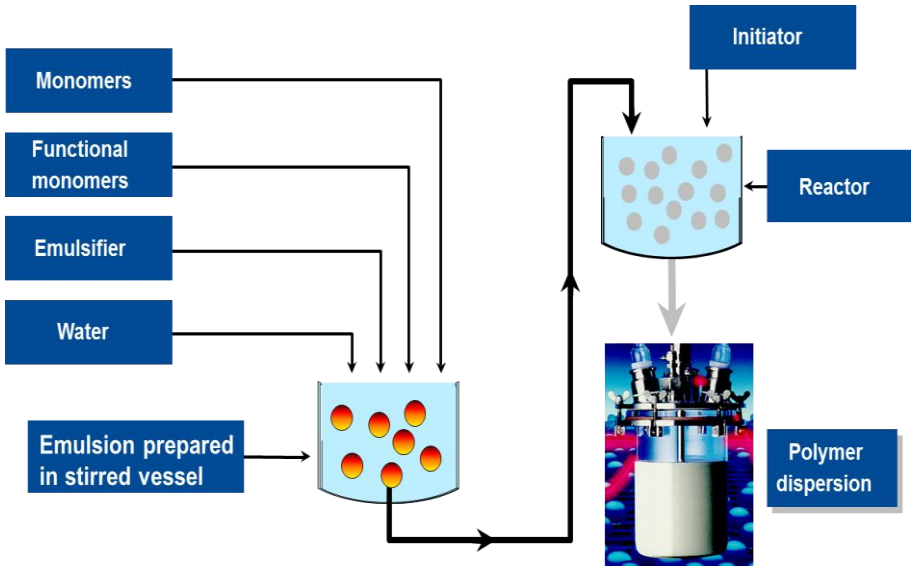
Challenges - High Solids Latex

Emulsion Polymerization STD Latex



1) Initially Polymerization at 53%
2) Chemical & Physical Deodorization
3) Condition ➔ ~ 50% Solids and Inherent Viscosity Range 100 -800 cps

Challenges in Polymerization Of High Solids Latex

RISK of

Reduction of Water

1 ***High Inherent Viscosity build-up***

2 ***Poor Latex Stability***

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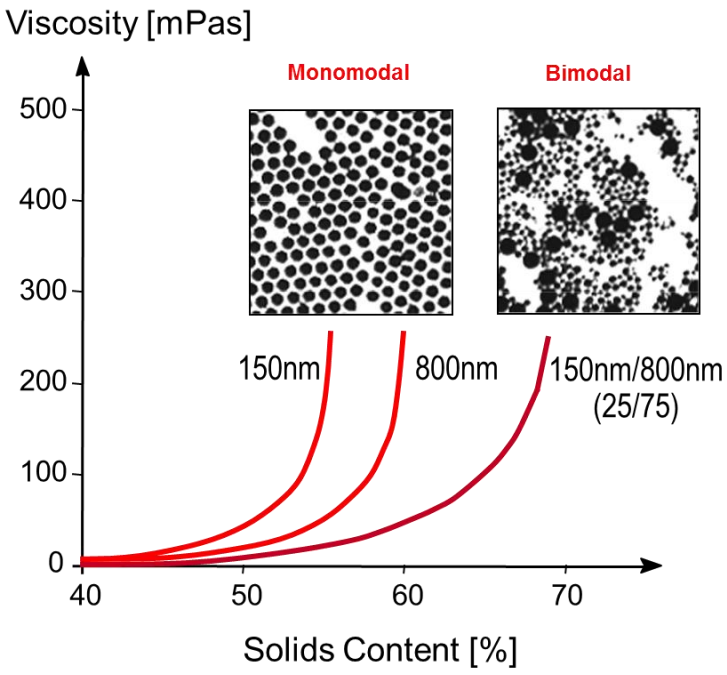
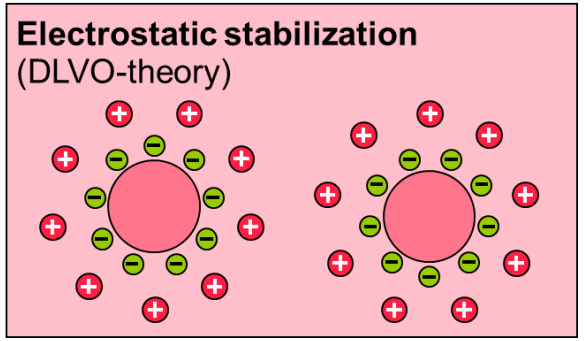
Challenges - High Solids Latex

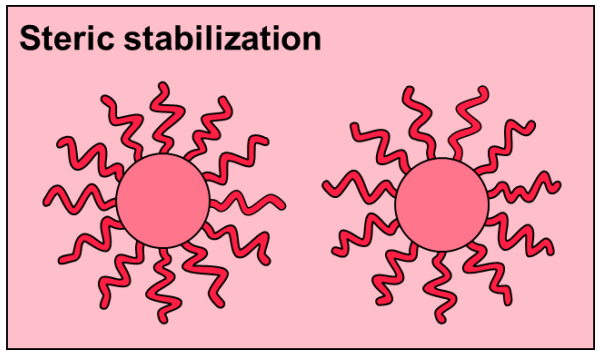
High Inherent Viscosity Build-up

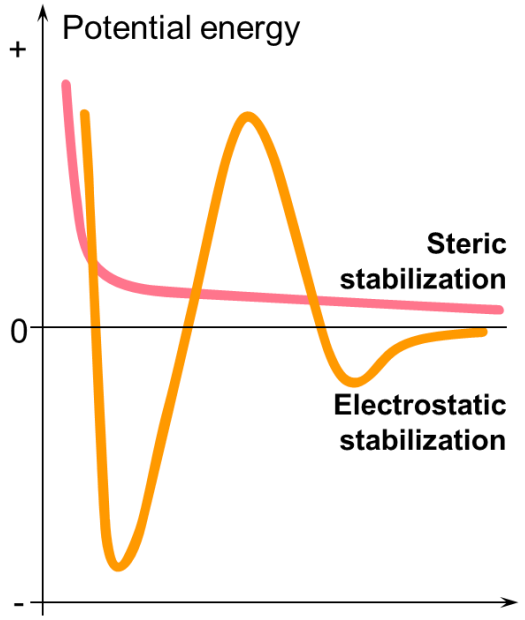


Viscosity is strongly depending on the particle size distribution

Poor Latex Stability







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Technical Concept – High Formulation Solids Latex

Innovative Technical Approach

1. Optimized Monomer Feeding Technology

Balanced control of PS & PSD

➔ **Minimize the inherent Viscosity**

2. Clever choice of Non-ionic renewable resource based steric stabilization

In-situ Polymerization onto colloidal surface

➔ **Imparts superior latex stability**

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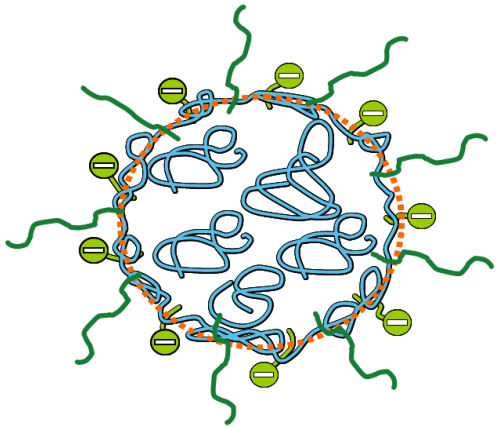
Value Proposition – Technological & Performance Benefits



Features

- Copolymer of Carboxylated Styrene-Butadiene
- Solids Content : > 55%
- Approx. Tg : 2º C
- Particle Size : Aprrox. 130 nm
- Lower Inherent Visc. :< 700 cps

High Solids Coating → Excellent Coater Runnability → Improved Drying Energy → Excellent Coater Properties

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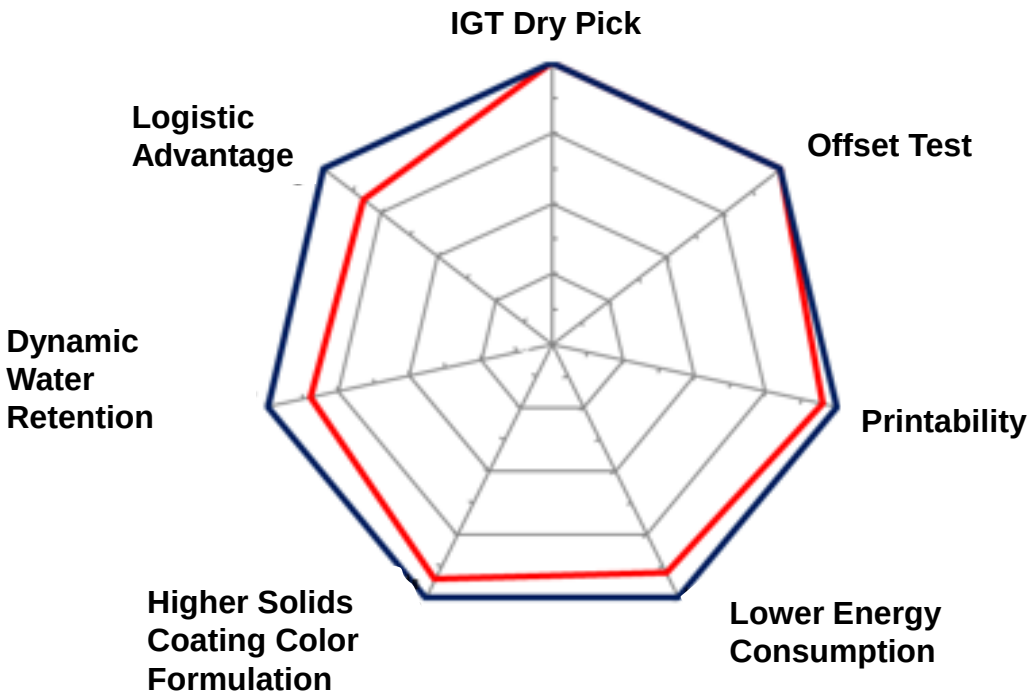
Value Proposition – Technological & Performance Benefits



Technical & Commercial Advantage

- ❑ *Improved Dynamic Water Retention*
- ❑ *Improved Coverage*
- ❑ *Better Smoothness & Sheet Gloss*
- ❑ *Excellent Offset & Gravure Printability*
- ❑ *Lower Dying energy Consumption*
- ❑ *Logistic advantage*

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Future Path Forward

Market Drivers & Requirements	BASF's Solution
N High Coating Solids	S *Styronal® 7926 X*
N Improved Coater Runnability	
N Energy saving	
N Improved Coated Board Properties	

Considering the market needs and requirements of the end users, it is recommended to take the advantage of the new advance products from BASF for mill trial to confirm the above

N *Needs* S *Solution*

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Trends

Sustainability & Food safety becoming prominent topic in P&B coating Industry

- Higher requirement seen in Asia – especially China
- Trends towards Stringent Food Compliances, Low VOC and “zero” Odor while maintaining the coated P&B quality
- Conventionally Food Packaging Grade
  - Comply with FDA (US) and BfR (Germany)
  - China – new food safety standard for Food Contact Materials (FCM)
  - China’s new stringent food compliance ➔ GB 9685:2016
  - Specific hygiene standard for use of additives in food container or packaging materials
  - Formaldehyde free

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Trends

- **Volatile Organic Component (VOC) requirements**
  - (YCT/207; 21 components < 40 ppm)
  - VOC concentrations can be quite accurately measured e.g. by sampling methods and GC analysis

- **Odor / Taint**
  - There are almost no legislative regulations for taint and odour
  - Maximum concentrations of substances, which contribute to odour are highly subjective and individual furthermore, extremely difficult to measure
  - Common test method is “Round Robbin Test”
  - Odor can also can be emitted during converting process

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Test Method
GC- Headspace & Direct Injection

VOC Test Method

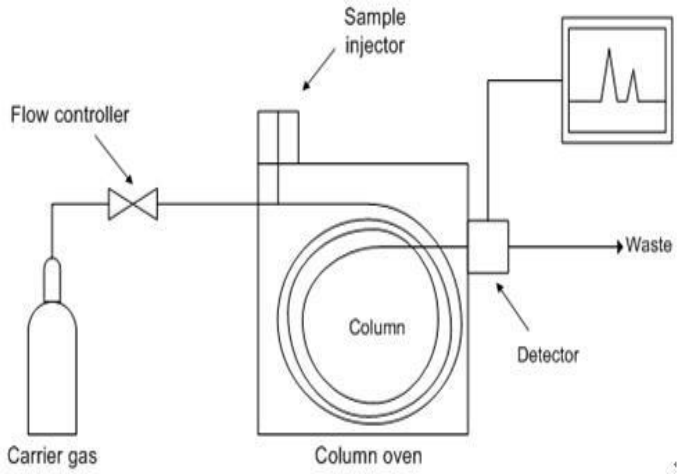
GC - Headspace

Headspace- paper coating						
Column	DB-1					
Inlet temperature	150		℃			
Detector temperature	250		℃			
Column temperature			40	℃	2	mins
	4	℃/min	180	℃	15	mins

- 21 Components
- YC/T207 < 40 ppm

GC - Direct Injection

GC direct injection						
Column	DB-1					
Inlet temperature	200		℃			
Detector temperature	260		℃			
Column temperature			50	℃	3	mins
	10	℃/min	130	℃	5	mins
	20	℃/min	200	℃	5	mins
	20	℃/min	220	℃	1	mins



- 11 Components
- Target 6 Components

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VOC specification (YC/T 207)

GC - Headspace

	VOC Items	Specification (ppm)
1	Methanol	<1
2	Ethanol	< 5
4	Acetone	< 0.5
3	Isopropanol	< 1.5
5	Methyl Acetate	< 1
6	n-Propyl alcohol	< 1
7	2-butanone	< 1
8	Ethyl Acetate	< 1
9	Benzene	<0.5
10	Isopropyl acetate	< 1
11	n-Butanol	< 1
12	1-methoxy-2-propanol	< 1
13	Propyl Acetate	< 1
14	4-Methyl-2-pentanone	< 1.5
15	1-Ethoxy-2-propanol	< 1
16	Toluene	< 2
17	Butyl Acetate	< 6
18	VCH	< 10
19	Ethylbenzene	< 7
20	Xylene	< 2
21	Styrene	< 8
	Total	**< 40**

Formaldehyde Free

GC – Direct Injection

	VOC Items	Specification (ppm)
1	Acetone	</=10
2	Methanol	</=10
4	Ethanol	</=10
3	**Styrene**	**</=20**
5	**PCH**	**</=60**
6	**VCH**	**</=10**
7	**Ethylbenzene**	**</=10**
8	N-Butyl Acrylate	</=20
9	Acrylonitrile	</=10
10	Toluene	</=10
11	n-Butanol	</=20
12	T-Butanol	</=10
	Total (VOC-EU, Tb < 250 C)	</=100-300

Formaldehyde Free

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Sources of VOC & Odor in P&B Coating

Components	Potential Source Of VOC & Odor
Base Paper & Board	Fibres and Wet-end Chemicals
Pigment Slurry	Dispersant, Neutralizing agent & Bacteria
Synthetic Binder	Neutralizing agent, by-products & Raw material impurities
Strach	Bacteria & Degraded Products
Thickners	Neutralizing agent & Residual Monomers
Crosslinkers	By-products
Wet Strength Agent	Neutralizing agent & by-products

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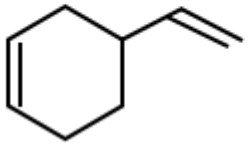
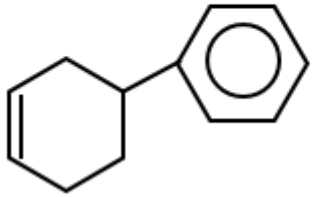
Sources of VOC & Odor in Paper Coating Binder

- Neutralizing agent : ammonia
- Volatile organic components (VOC) :
  - ✓ S / Butadiene : Styrene , VCH , PCH
  - ✓ VCH : vinyl cyclo hexadiene - Diels-Alder product of Bu + Bu

4-VCH 

  - ✓ PCH : phenyl cyclo hexadiene - Diels Alder product of S + Bu


4-PCH

  - ✓ Formation of C-12 Olefins by CTA

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BASF innovation activities to address challenges - Reduce VOC & Odor & GB 9685:2016 Compliance

Innovative Activities taken to minimize VOC & Odor

1 Optimized Production process	**Styronal® ES**
2 Flexible Production Technology	**Basonal® FCB**

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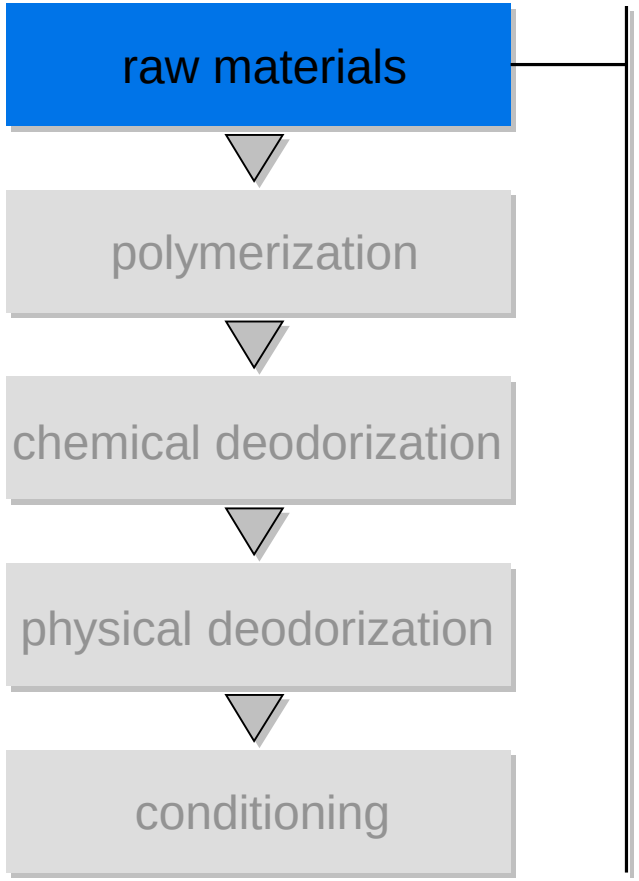
Optimized Production Process to Reduce VOC & Odour & GB 9685 Compliance

Steps being taken to minimize VOC & Odor



- ❑ minimizing side components of monomers from the suppliers:
  e.g. - Styrene (EB, Xylene, Toluene)
  - Butadiene (VCH)

- ❑ GB 9685 Compliant raw materials

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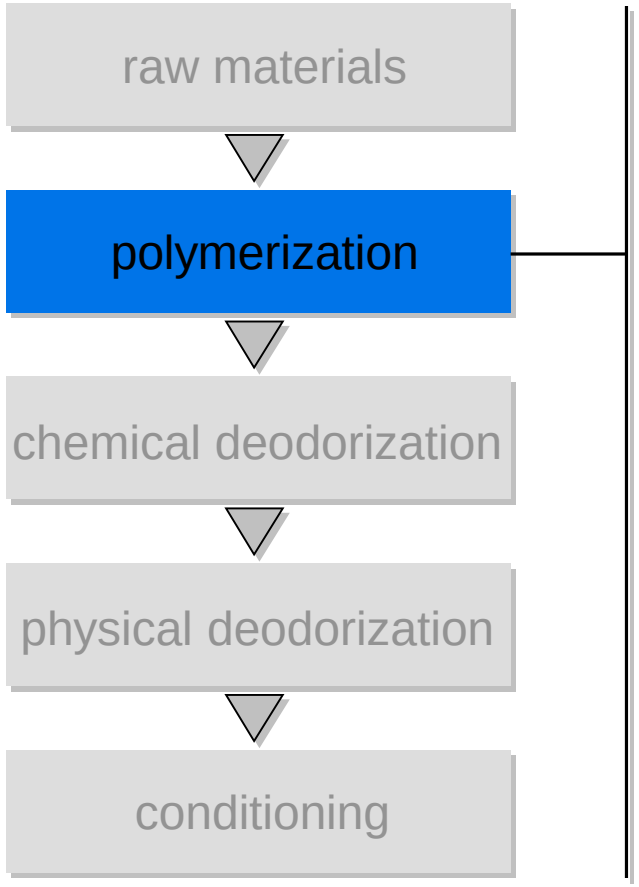
Optimized Production Process to Reduce VOC & Odour & GB 9685 Compliance

Steps being taken to minimize VOC & Odour



- ❑ Optimizing process conditions (Special feeding…)
- ❑ Optimizing recipe parameters with special CTA

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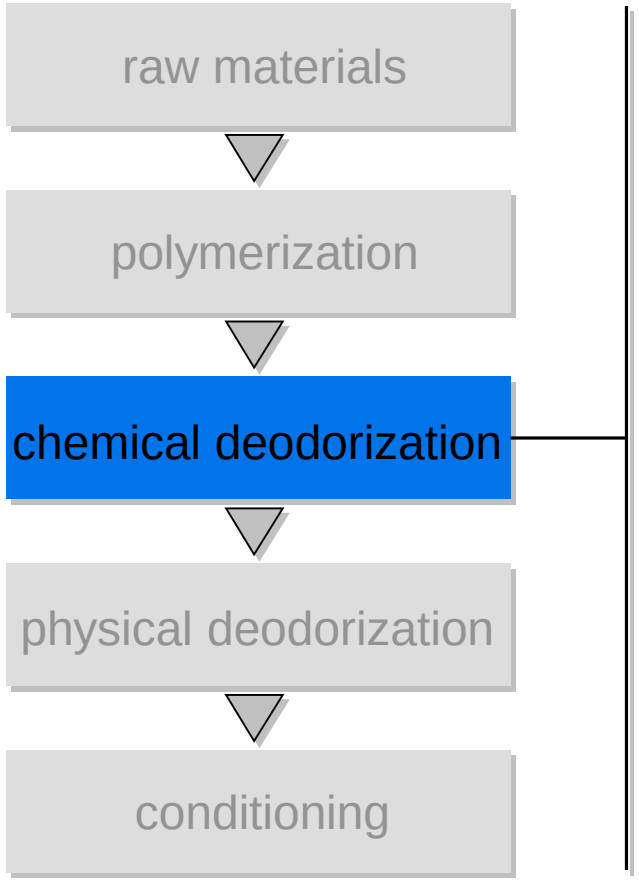
Optimized Production Process to Reduce VOC & Odour & GB 9685 Compliance

Steps being taken to minimize VOC & Odour



- ❑ Optimizing the Chemical Stripping conditions
- ❑ To minimize the residual monomers (Redox System)
- ❑ Use of formaldehyde free redox systems

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Optimized Production Process to Reduce VOC & Odour & GB 9685 Compliance

Steps being taken to minimize VOC & Odour

raw materials

polymerization

chemical deodorization

physical deodorization

conditioning

- ❑ Advanced column deodorization
  (~ 20-25% steam/dispersions)
- ❑ To minimize residual organic components

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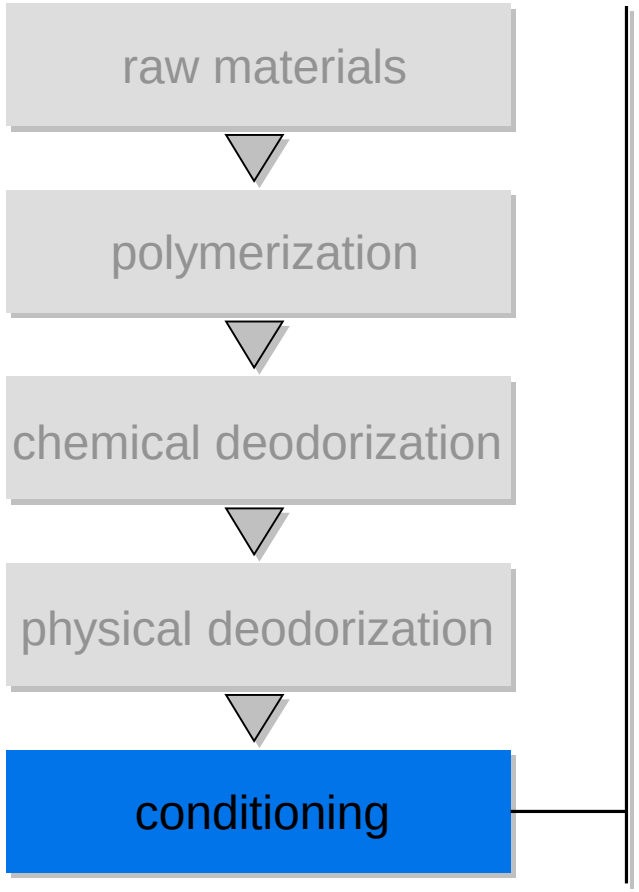
Optimized Production Process to Reduce VOC & Odour & GB 9685 Compliance

Steps being taken to minimize VOC & Odour



- ❑ Use of sodium hydroxide to adjust pH
- ❑ Use of organic solvent free Biocides
- ❑ Use of FA free Biocide

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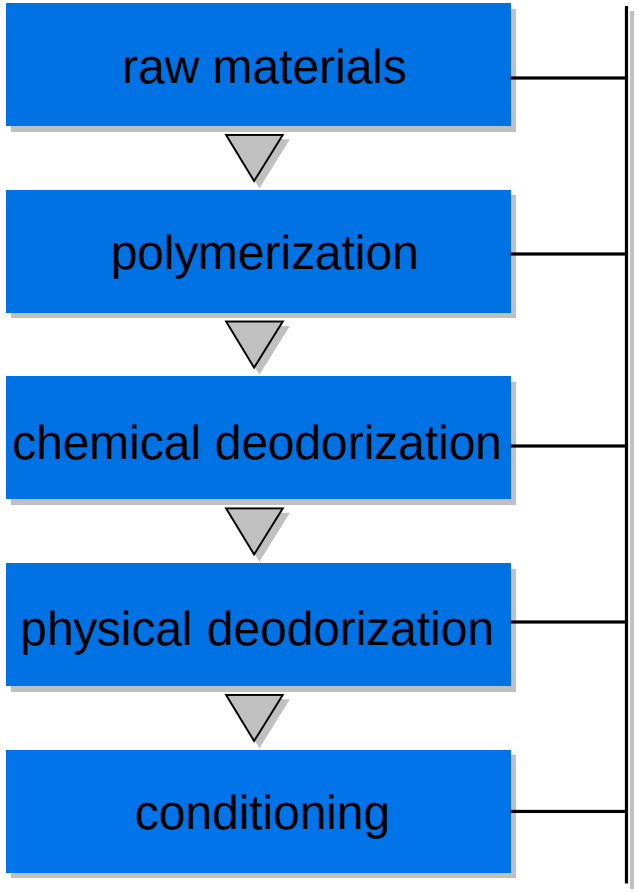
Optimized Production Process to Reduce VOC & Odour ➔ Styronal® ES Grades & GB 9685 Compliance



Styronal® ES

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Our Styronal® ES grades – Standard Products with optimized VOC and low odor & GB 9685 Compliance

Product Name	Film properties (1)	Odor	GB 9685 (2)	FDA reg. 21 CFR (2) 176.170	FDA reg. 21 CFR (2) 176.180	BfR XXXVI (2)	Remarks
Styronal® ES 7900	soft	low	yes	yes	yes	yes	▪ High binding power latex, esp. suitable for precoat applications
Styronal® ES 7902	medium	low	yes	yes	yes	yes	▪ Standard overall performance latex, suitable for both precoat and topcoat applications
Styronal® ES 7936	medium-hard	low	yes	yes	yes	yes	▪ Best suitable for topcoat applications with high requirements in terms of printability and convertibility

(1) Film properties: <= 0 °C: soft; 0 – 10 °C: medium; 10 - 20 °C: medium-hard ; > 20 °C: hard ;
(2) In any case regarding food contact status, the above does not replace the detailed information in the Food Contact Compliancy statement. For more detailed information on specific country requirements and conditions of use, please refer to the relevant Food Contact Compliancy statement. Please contact your account representative to get the full statement.

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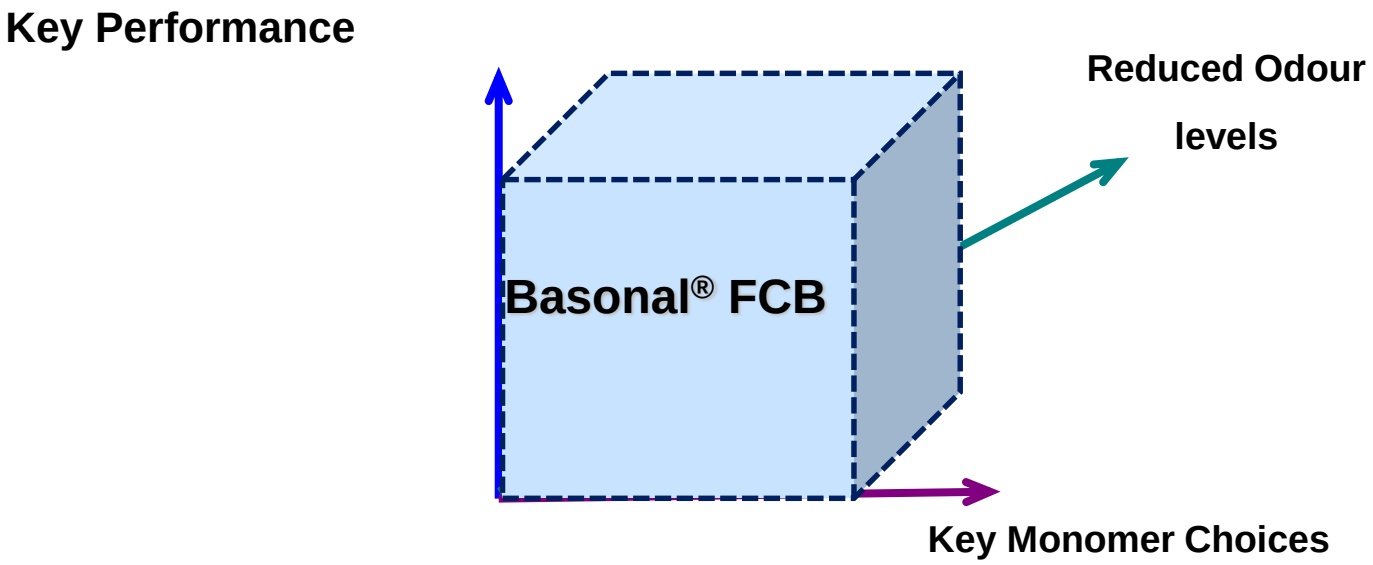
BASF‘s Solution:
Binders with Minimum Odor and volatiles

Highly optimized flexible production technology



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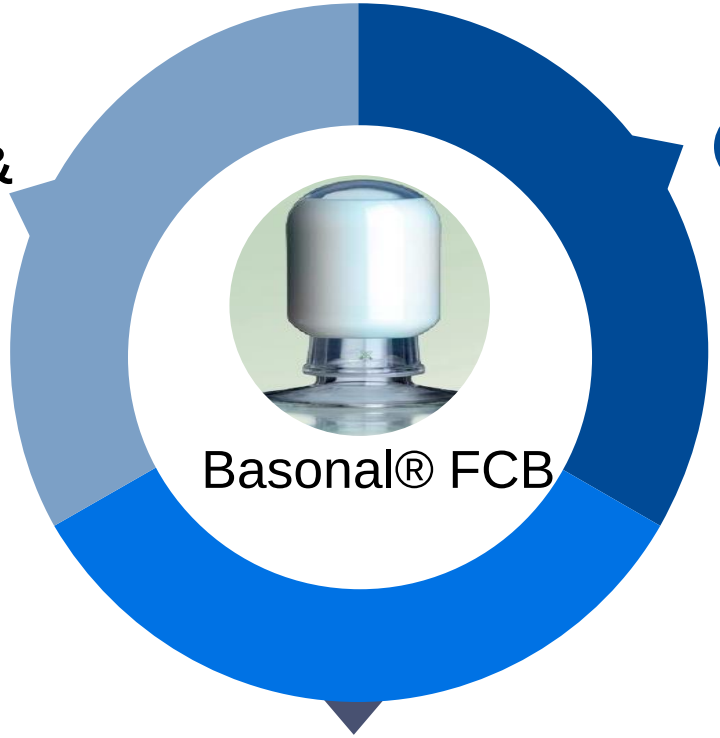
Basonal® FCB – Tailor-Made 3-in-1 Solution for Food Contact Board

Basonal® FCB – Our BASF 3-in-1 Solution for Food Contact Board

1 **Low Odor & Low VOC**

2 **Excellent Printability**



3 **GB 9685 Compliant**

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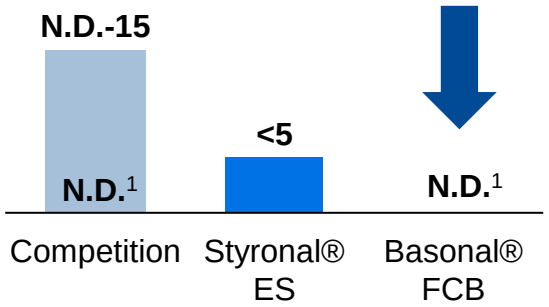
LOW ODOR – from latex production all the way to the end consumer

1 **Low Odor & Low VOC**

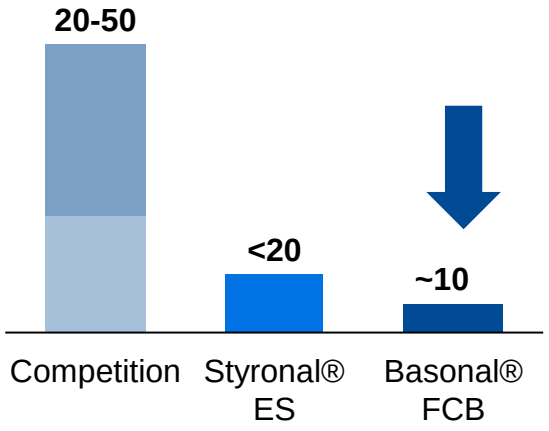
Latex | **UV Printing**

VCH (the lower the better)



Odor Ranking

PCH (the lower the better)



BASF Advantages:

- ❑ Lowest VCH and PCH
- ❑ Lowest odor after UV printing

1 Non-Detectible

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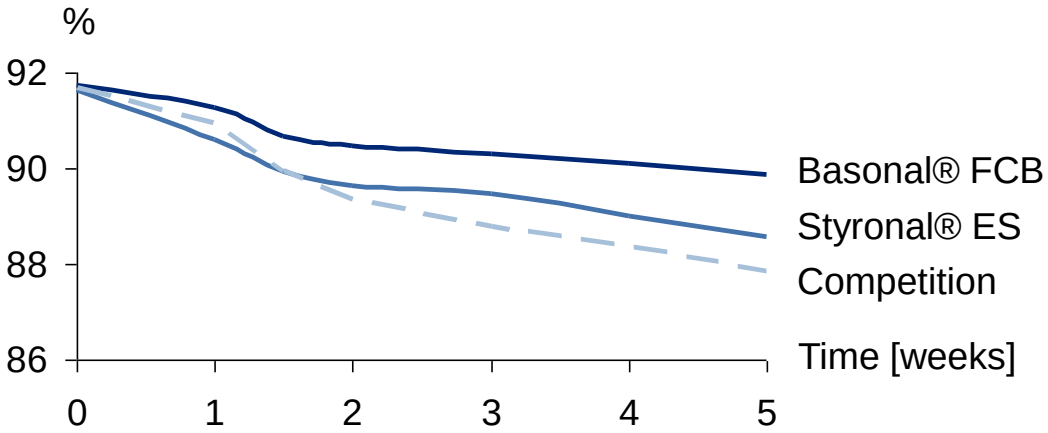
SUPERIOR PRINTABILITY in terms of ink absorption, brightness, mottle and yellowing

2 **Excellent Printability**

- ✓ **Excellent Brightness**
- ✓ **No Yellowing over time**
- ✓ **Excellent Mottle**
- ✓ **Good water/ink balance**

Yellowing Index

CIE Brightness stored @ 40 ºCover a period of 5 weeks



Mottle

Basonal® FCB

Competitor

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FULLY COMPLIANT with all common regulatory standards including the latest GB 9685-2008

3 **GB 9685 compliant**

Basonal® FCB complies with all common standards

- ✓ **GB 9685 – for paper application**
- ✓ US FDA 176.170 and 176.180
- ✓ Germany BfR XXXVI

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Our Tailor-Made Basonal® FCB Grades for high- performance Food Contact Board

Product name	Film properties (1)	Odor	GB 9685(2)	FDA reg. 21 CFR (2) 176.170	176.180	BfR XXXVI (2)	Remarks
Basonal® FCB 7961	soft	very low	yes	yes	yes	yes	Tailor-Made, low VOC / very low odor latex grades with outstanding printability
Basonal® FCB 7962	medium		yes	yes	yes	yes	
Basonal® FCB 7963	medium		yes	yes	yes	yes	

(1) Film properties: <= 0 °C: soft; 0 – 10 °C: medium; 10 - 20 °C: medium-hard ; > 20 °C: hard ;
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Summary

Higher requirements for VOC and Compliances becoming important in Asia

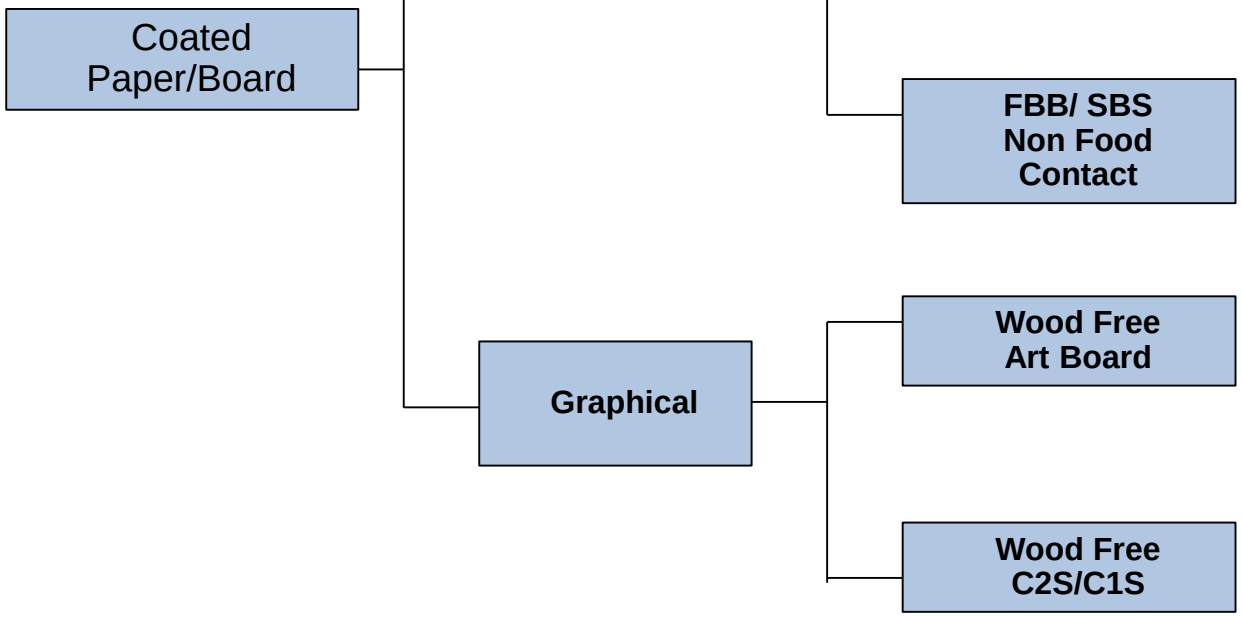
Trends towards GB 9685 compliance, low VOC and “Zero Odour” with no compromise in quality

- BASF has added **Styronal® ES grades** to it’s standard portfolio (Styronal® and Acronal®)
- In addition to that, the recently developed novel 3-in-1 Basonal® FCB grades are available to meet stringent customers demand for food contact board segment

BASF

We create chemistry

Coated paper & board – Market needs



- Consistency of quality
- Managing deteriorating furnish
- Cost & Quality performance
- Printability
- Managing needs of exports / Compliance

- Complying to Food Contact laws
- Smoothness and Printability
- Convertibility
- Odor of the board

- Printability
- Convertibility – Stiffness, Bulk, Glueability
- Cost & Quality performance

- Printability
- Convertibility – Crack-at-fold
- Cost & Quality performance

- Cost & Quality performance
- Suitability for Flexible packaging
- Printability
- Cost & Quality performance

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