

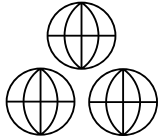
SUSTAINABLE BARRIERS FOR PACKAGING

Opportunities and Challenges

By - Mr.Cyril Coumans, Product Manager , Archroma
- Mr.Amin Purnomo, R & D Manager , Archroma



Global trends are driving the need for sustainable solutions



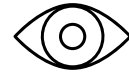
Three planets required by 2050

Growing population, growing buying power and increasing demand on resources



Environmental damages & pollution

Climate change, water supply and waste are becoming more obvious issues for end-consumers



Awareness change

Customers, regulators and markets support ethical behaviour and sustainability commitments



Demand for alternative materials

Products from recycled or biobased materials are expected to grow strongly until 2030 and beyond

We are committed to deliver a more sustainable future for our customers and markets

Paper Market Trends & Drivers

Description

Plastic substitution



- **Concerns around plastic waste** continues to be deeply rooted with consumers, additionally fueled by regulations limiting plastics; **however, perspectives become more nuanced (e.g., deforestation)**; long-term risk of changing consumer sentiment
- **SBS & kraft paper** expected to continue to benefit due to **similar use cases** as plastic solutions

E-commerce



- **Online penetration has substantially grown during Covid**, requiring more secondary packaging vs. offline; **sustained behavioral shift** to more frequent online shopping expected
- Especially **containerboard suited for logistical applications**; only minor shift to other substrates expected, e.g., light-plastic bags for apparel

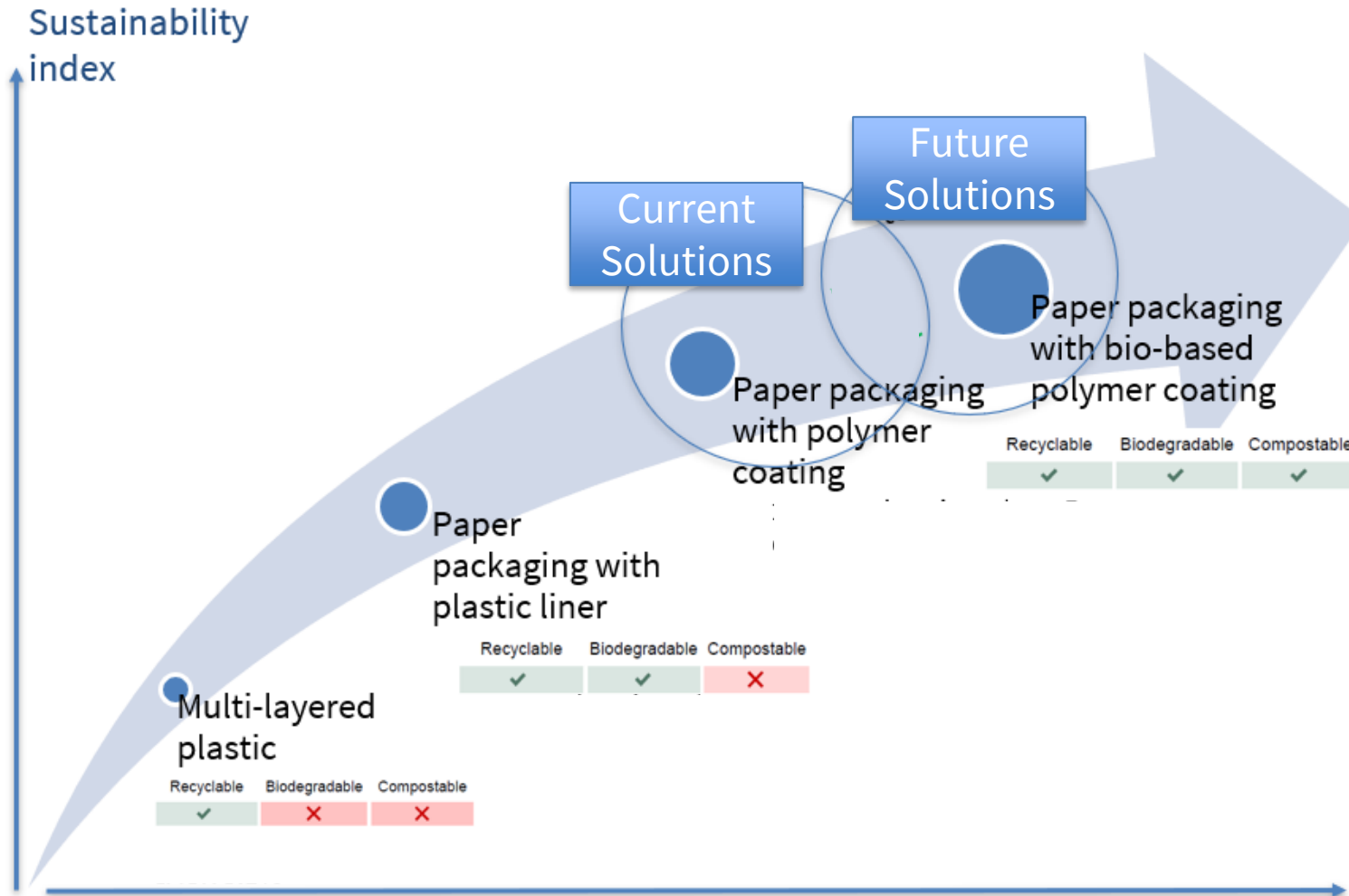
Government green regulations



Management (Amendment) Rules 2021 on 12 August 2021, prohibiting the manufacture, import, stocking, distribution, sale and use of the identified Single-Use Plastic items with effect from 1 July, 2022.

- In November 2022, the EU published a revised legislation on Packaging (Waste) to **prevent packaging waste, boost reuse and refill**, and make packaging fully recyclable by 2030
- **Select packaging forms are planned to be banned if deemed unnecessary**, including, e.g., single-use for food/ beverages consumed inside of cafes and single-use for fruits/ veggies

Development in Paper Barrier solutions – *Towards sustainable solutions*



Can we enjoy our food straight from a packaging that doesn't cost the earth?



WE LOVE:

- Buying or eating food from a wrap or box that stays free from stains and leaks
- Paper-based packaging, knowing it will not end up polluting nature and endangering wildlife for centuries

BUT DID YOU KNOW:

- Paper-based food packaging is sometimes lined with a plastic film that makes composting or recycling difficult...
- ... or with chemicals that can be potentially harmful to our health and to the environment

Developing New Solutions for Oil & Grease (OGR) Barriers

PFAS free based solution

- Fluorine-free* water-based coating
- Ideal replacement of paraffin waxes, fluorochemicals or polyethylene for paper and board
- End products can be recycled and are compostable

Applications in a wide range of end articles:

- Folding box boards
 - Corrugated boxes
 - Paper plates
 - Fast Food Service
 - Ice Cream Box
-
- Food contact compliant according to FDA and BfR requirements
 - Can be applied with Air-knife, Bar, Blade

A plastic, fluoro and paraffin wax replacement



* Below limits of detection according to industry standard test methods

Transitioning to improved water based alternatives for OGR

Material, Methodology & Results

Objective : Comparing the Performance of Current Water based Barrier ("Benchmark" in the graph) and New Grease Barrier (NGB) "Archroma NGB" In the graph for OGR and moisture vapor resistance.

Test Methodology

- KIT test according to TAPPI Test Method T559, consisting in testing the degree of repellency and/or the ant wicking characteristics of paper or paperboard.

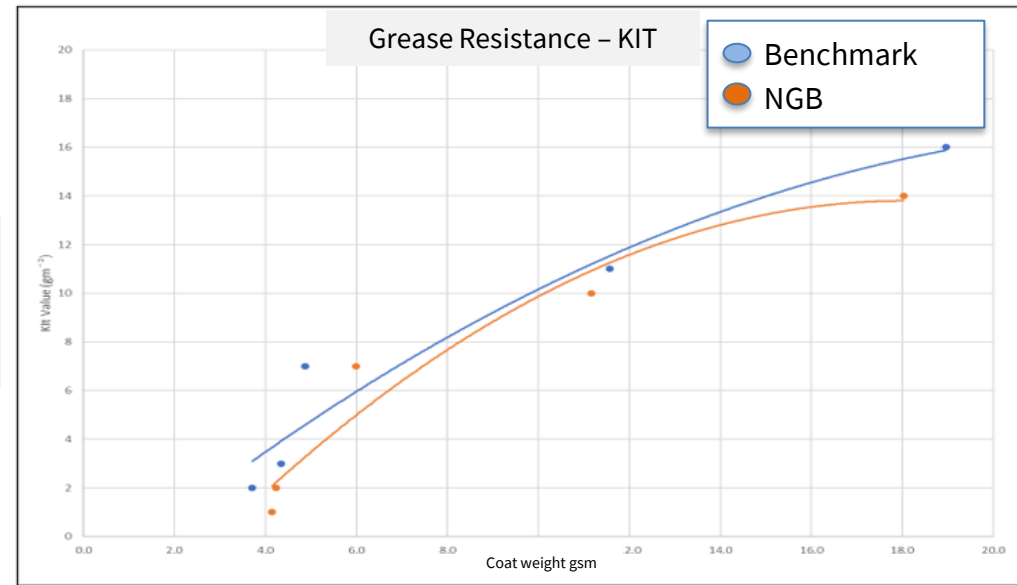
Base paper used for all lab evaluations:

- 90 gsm
- RK/Sheen automatic drawdown coater

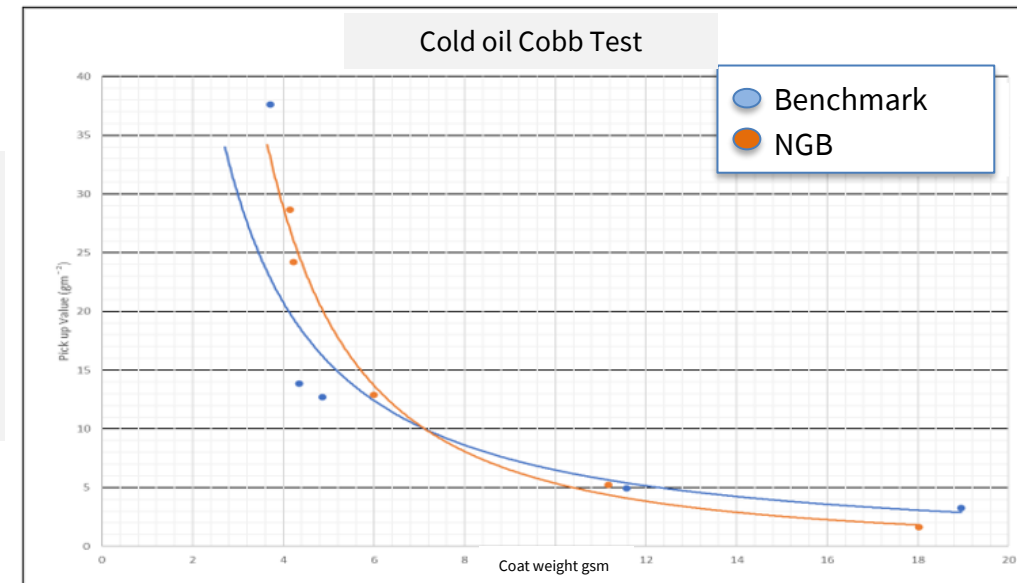
Results :

- **Kit Test**
Similar Performance as Benchmark.
- **10 minute cold oil Cobb test**
Similar performance as Benchmark .

Kit Value



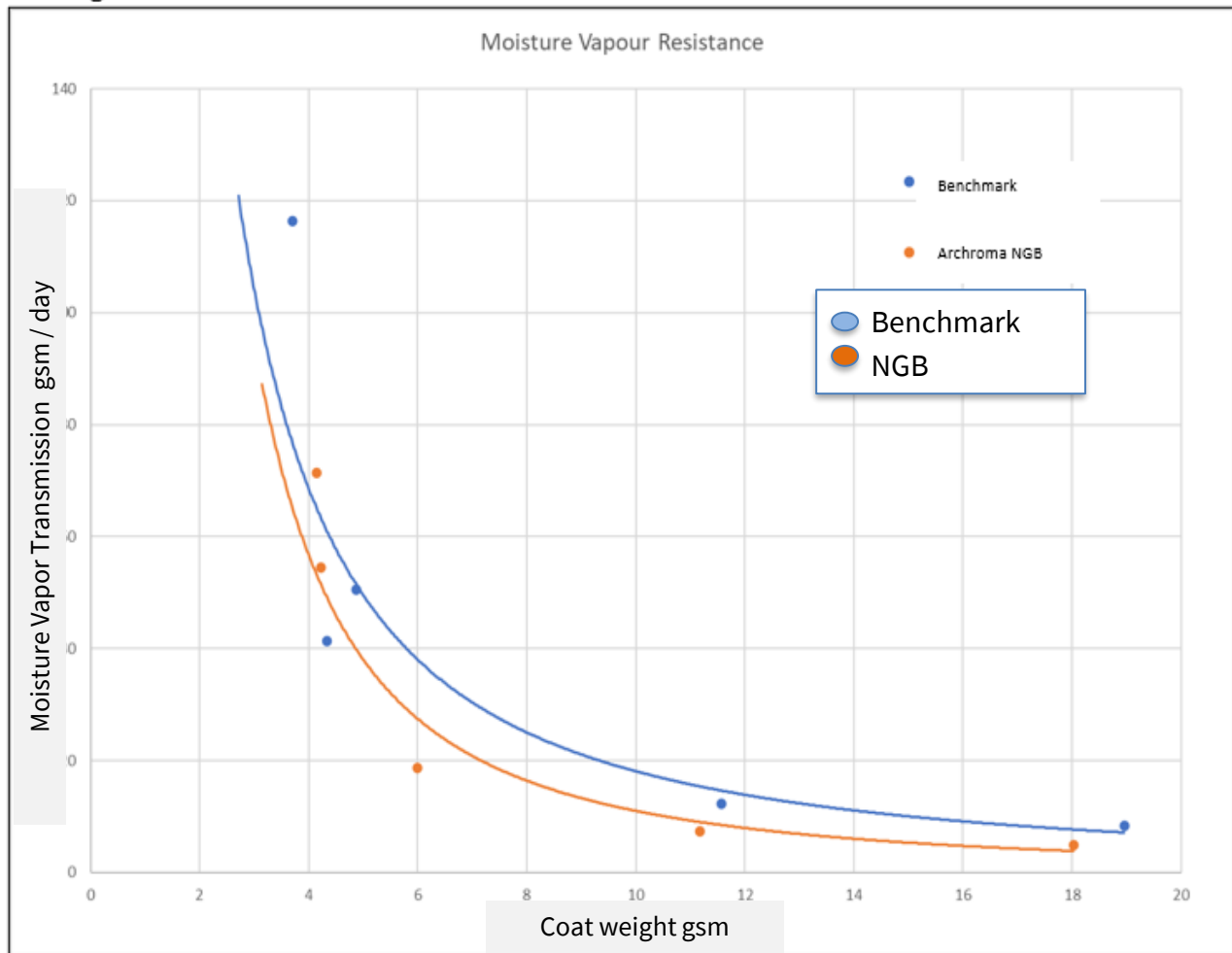
Pick up Value gsm



Moisture Vapor Transmission Rate : For some applications such as wrap paper for fast food, the moisture resistance is also a critical characteristic. The test below shows that the performance of the new water-based coating is better than the benchmark:

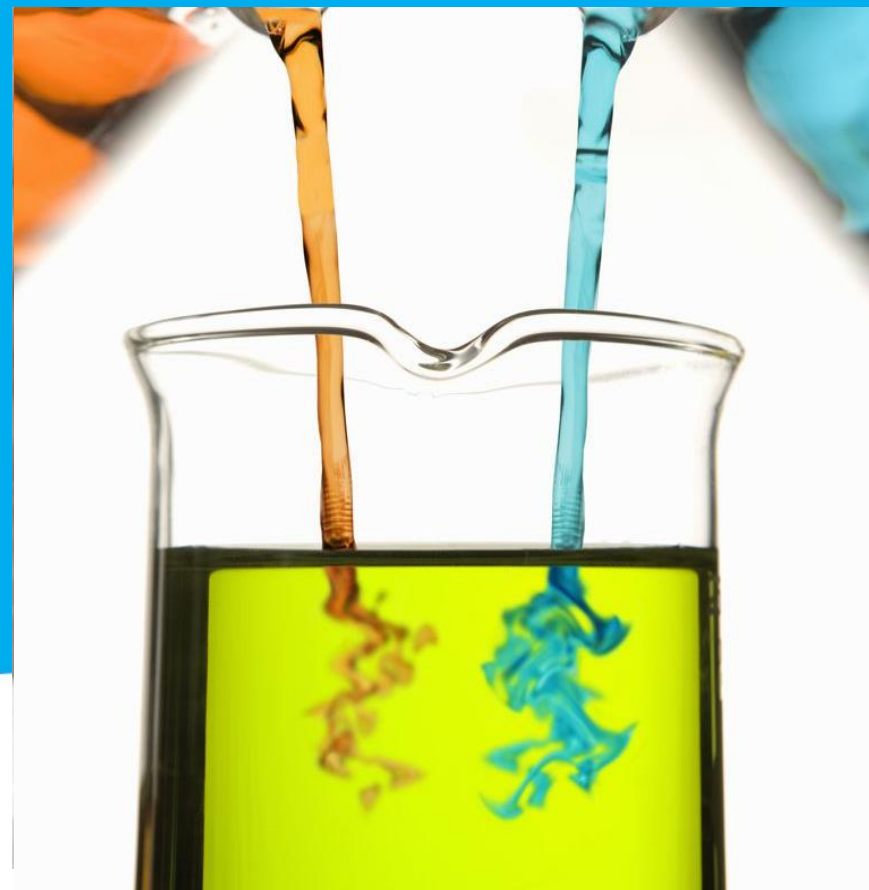
- Base paper used for lab evaluations
 - 90 gsm
 - RK/Sheen automatic drawdown coater
- MVTR carried out at under temperate conditions
 - 23°C, 50% relative humidity
 - Gravimetric method
 - Results are good and in line with expectations

Next step: Evaluate the possibility to improve the barrier performance by combining it with other Archroma barrier products or crosslinkers.



BLENDING BARRIER CHEMISTRIES

**Combining Products to Provide
Multi-Functionalities**



Blending chemistries: when 1+1=3

1- Improving heat sealing

Typical End Uses

- Dry food packaging, sauce pots, ice-cream tubs, single use plastic replacement

Target

- Applications that require good water resistance, grease resistance, moisture vapour resistance AND heat seal.
- Typical heat seal conditions; 220°C, 70 Psi with ~0.8s dwell time

Application

- Air-Knife, Bar, Blade, Curtain



*Developing customized Solutions to meet specific barrier needs ...
balancing Heat sealing and Oil , Grease and Water repellency .*

The performances of the new water-based grease barrier are superior to existing market solution. However, OGR Barriers may lack in heat seal performance

Results of Heat Sealing Performance – by various combinations of the New Grease Barrier (NGB) and Heat Seal Coating (HSC)

% NGB	% HSC	Pressure (in Bars) Variable Sealing Temperatures 200° C					
		0,5	1	1,6	2,3	2,6	3
60	40	NO	NO	NO	NO	NO	4,0 N
50	50	NO	NO	NO	3,8 N	4,2 N	4,6 N
45	55	2,7 N	3 N	4,9 N	4,4 N	4,6 N	4,6 N
40	60	2,9 N	3 N	4,3 N	4,4 N	4,5 N	4,5 N

Conclusion: For the 110 g/m²board, blending 45 % NGB + 55 % HSC can provide sealing with 0.5 Bars (we were not able to test below 0.5 Bars), ideally 1 Bar.

The current coating developed by for heat-sealing application, has been one of the eight solutions winning the Next-gen cup challenge.

Blending chemistries: when 1+1=3

2- Improving Barrier Performances

Archroma have a broad range of water based cross-linkers which are commonly used in the paper industry as highly effective surface strength improvers.

They crosslink with a wide variety of natural and synthetic binders to improve the surface structure of the sheet to reduce dusting, picking and linting at the paper surface because the amount of weakly bonded particles and fibers has been reduced.

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Experiment to evaluate the interaction between the New Grease Barrier solution (NGB) and a Crosslinker (CLK) and measure the effect on barrier performance

Cobb Test with different ratio of Crosslinker (CLK)

Products	Coat Weight (g/m ²)	Cobb 30 min (g/m ²)
NGB	4.3	30
	9	2
NGB + 1% of CLK	4.7	11
	9	3
NGB + 2% of CLK	4.7	12
	9.2	2
NGB + 3% of CLK	4,7	13
	9	2

At the highest coat weight, all samples have the same good results.
For Cobb test, the best solution is NGB + 1% of CLK.

Corn Oil Test with different ratio of Crosslinker (CLK)

Products	Coat Weight (g/m ²)	Corn oil test 10 min (g/m ²)
NGB	4.3	10
	9	2
NGB + 1% of CLK	4.7	2
	9	1
NGB + 2% of CLK	4.7	2
	9	0
NGB + 3% of CLK	4,7	2
	9	0

At the highest coat weight, all samples have good results.
At low coat weight, papers treated with NGB and CLK show better results compared to the reference (NGB only)

KIT Test with different ration of Crosslinker (CLK)

Products	Coat Weight (g/m ²)	KIT
NGB	4.3	8
	9.7	12
NGB + 1% of CLK	4.7	9
	9.2	13
NGB + 2% of CLK	4.7	8
	9.2	16
NGB + 3% of CLK	4,7	8
	9,3	16

At higher coat weight, the difference between each product is more visible. Papers treated with NGB and CLK are more resistant than NGB alone.

At low coat weight, the gap between the products tested is less important, although the results are slightly better when we add more Crosslinker (CLK).

For all coat weights, when we add CLK, grease and oil resistance increase

Conclusion: The experiments show that adding a small percentage of crosslinker to the grease barrier coating has a positive effect on the barrier performance. Therefore, we recommend the addition of 1 to 2% of crosslinker into the formulation depending on the final application

NEXT GENERATION

Bio based barriers



Nature-based barrier for food contact applications – existing solution

Archroma have already commercialized a water-based barrier made with over 30% natural and renewable components

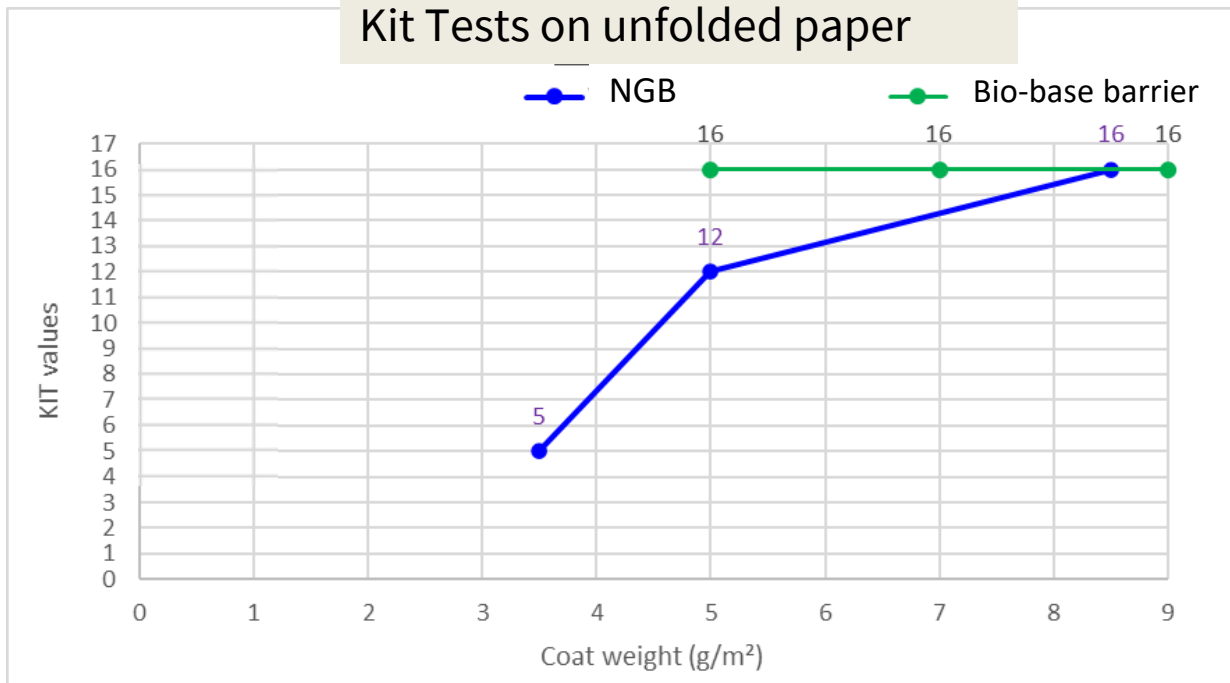
- Reduces the need for fossil fuel resources without compromising on the performance
- Resistant to oil, grease and water for general food packaging used with a short contact time
- Ideally suited for burger or sandwich paper wraps
- A more sustainably responsible option so end products are more easily recycled and compostable
- It is a PFC-free alternative for food packaging barriers and compliant with the food contact regulations of BfR, FDA & China (GB 9685-2016)



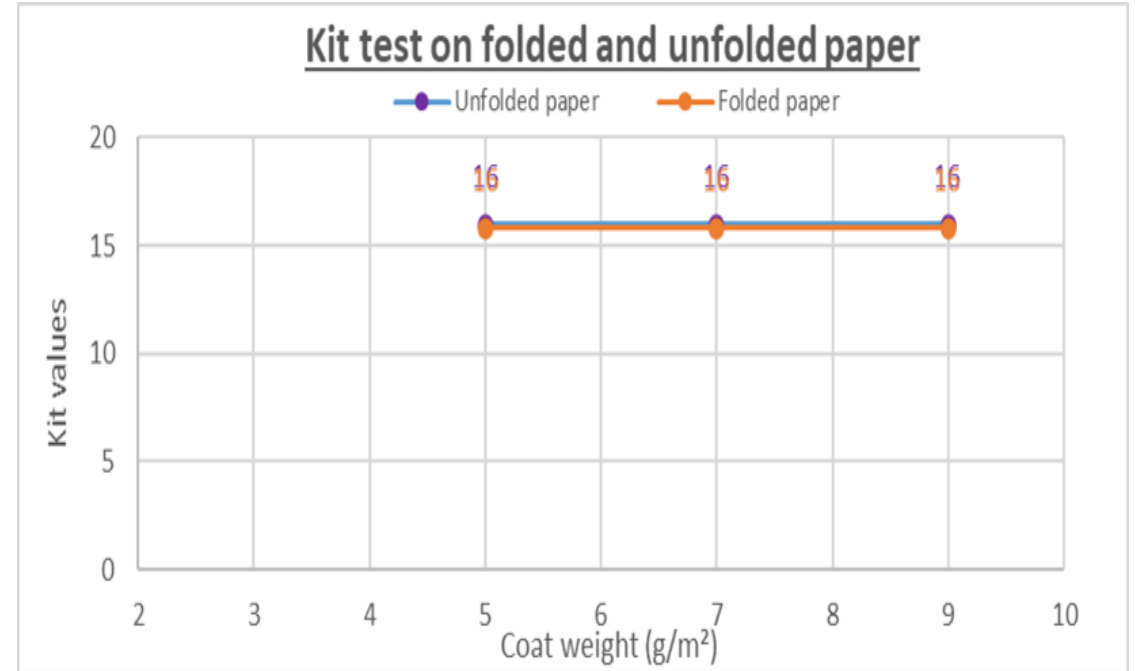
New Bio Based solution

- Promising Innovation

Kit Tests on unfolded paper



Kit test on folded and unfolded paper



A solution under development containing 40% bio based material is under development. The goal is to propose a competitive alternative to water-based coating using 100% fossil fuel based raw materials.

Bio Based Binder outperforms NGB in OGR properties and does not drop KIT after folding.

CONCLUSION

The study we shared shows that

- Water based solutions providing excellent barrier to oil and grease are available from our company .
- No One Fit All Solution : Based on the experience acquired with many customers, we know that it is difficult to develop a one-fit-all solution and, the good approach is to combine chemistries based on the application and performance requirements.
- Growing consumer push for sustainable solutions - Innovative Bio Based Barrier to be launched by end 2023.

We continue to think ahead and work on products with minimal environmental footprint .



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