

Sustainable oil & grease barriers for paper packaging

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INTRODUCTION:

Current and pending packaging regulations and heightened consumer sensitivity to environmental impact are pushing the packaging market to reduce the utilization of plastic. In many cases, paper packaging is the alternative of choice, however there are some limitations of traditional paper packaging as a replacement for plastic. When transitioning from plastic to paper, it is important to provide effective barrier solutions in striking a balance between sustainability and functionality.

The key requirements for paper barrier solutions in packaging are recyclability, compostability, food compliance, and performance in end application such as water, oil and grease barrier for food packaging. Understanding these requirements is crucial in developing effective sustainable solutions.

The highest performing coatings on the market are based on per fluorinated compounds (PFC's) or are solvent based; thus, there is an imperative to develop sustainable chemistries.

In the following article we will show how we applied our years of experience in the paper industry with our extensive formulations knowledge to create a new solution developed for oil barrier application to address this challenge.

Key Words: Sustainable Packaging, Paper Barrier, Oil & Grease Barrier, Water-based coatings, Bio-based coatings

In this article we will focus on specific barrier needs, with a particular emphasis on oil and grease resistance. We will introduce our groundbreaking water-based non fluoro based alternative as an exemplary solution that balances enhanced functionality with reduced environmental impact.

Transitioning to Water-based Alternatives for Oil and Grease Resistance:

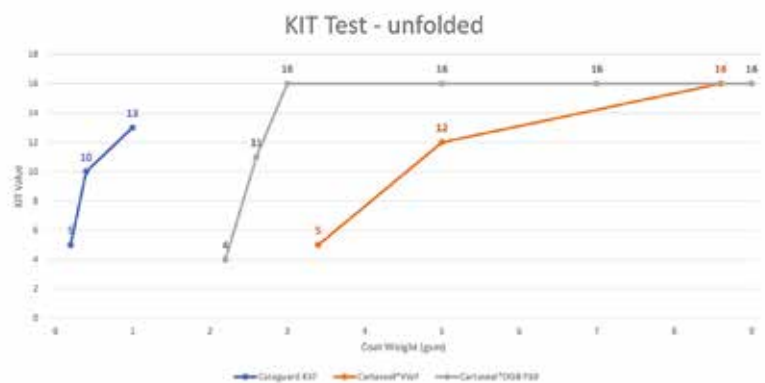
The packaging industry is making considerable effort to reduce its dependence on oil-based coating materials; eliminating PFAS in barrier coatings; and diminishing the use of solvents in coating production.

Around 40% of the total volume of functional and barrier coatings on paper and board packaging applications is used on packaging food for human consumption but we notice an increasing usage in pet-food and non-food applications. As a consequence, the total demand for barrier coating will grow at around 4.8% in the coming years.¹

The foodservice, fresh food and bakery segments are the top ones requiring alternatives to existing packaging solutions for fast food snacks, sandwich wraps, paperboard trays for fresh food, such as meat, fish and cheese.

The best coating solutions available today for oil and grease barrier are based on per fluorinated compounds (PFC). As companies are looking to transition away from PFC materials, more environmentally friendly water-based alternatives are needed. Archroma has been working on improving the performance of their benchmark water based barrier and has launched a new solution providing better oil and grease resistance: Cartaseal® OGB F10. One important characteristic of this new coating is that it contains some bio-based components.

GREASE RESISTANCE - KIT TEST unfolded



This is a major element of our innovation strategy: moving towards fully biodegradable solution, but we believe that it must not be detrimental to the performances and functionalities associated with traditional barrier coating.

We have developed this coating knowing that it will be applied by converters but also directly by paper mills which are investing heavily in this technology.

The graph above shows the performance of Cartaseal® OGB F10 compared to two other coatings produced by Archroma: Cartaguard KST, which is a fluoro based coating and Cartaseal® VWF, a versatile paper barrier. Kit test run according to TAPPI Test Method T559. The higher the value, the higher the grease resistance.

As shown on this lab study Cartaseal® OGB F10 is a very good alternative to Fluoro based coatings as it provides a very high KIT performance with very low coat weight.

Grease Resistance - Cobb

The Cobb test (right) shows the barrier performance of Cartaseal OGB F10 exposed during 30min to vegetable oil.

The Cobb test determines the amount of oil that is taken up by a defined area of cartonboard through one-sided contact with oil, within a certain amount of time (here: 1800 seconds) – the lower the value, the better the performance. To develop new sustainable packaging solutions that have lasting barrier performance one important criteria that is required is the ability for the coating to hold properties after folding the bow board. This is a clear limitation of most coatings available on the market and it was a criteria we wanted to address with Cartaseal® OGB F10. This criteria is increasingly critical as more and more brands are asking to develop solutions for paper flexible packaging such as pouches or wraps.

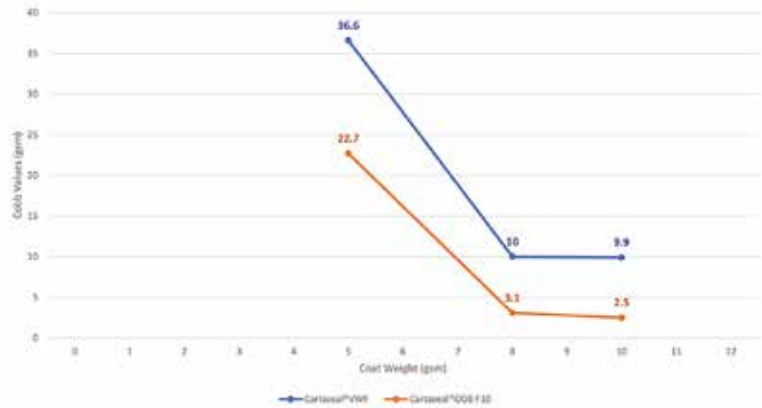
To assess the performance of Cartaseal OGB F10 for this type of applications, we conducted similar test as above but on folded paper:

Grease Resistance - KIT Test after folding

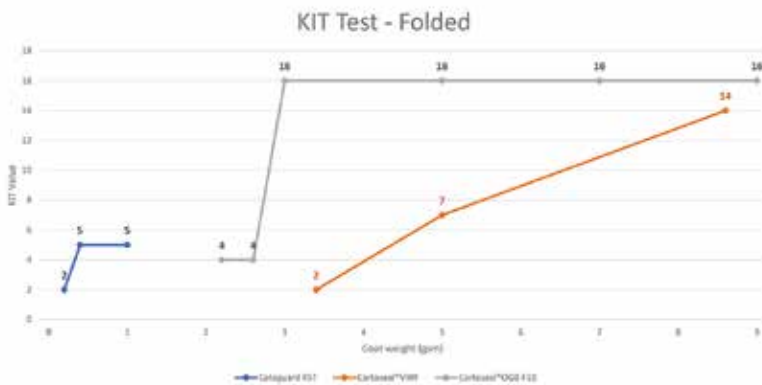
Oil and Grease barrier of Cartaseal® OGB F10 are not affected by folding and it is the only solution to keep a value above 12 after folding.

The pictures below are showing the vegetable oil test specimen coated with Cartaseal® VWF and Cartaseal® OGB F10 before and after folding.

30 min. VEGETABLE OIL COBB



KIT Test - Folded



VEGETABLE OIL TEST SPECIMEN - BEFORE FOLDING



VEGETABLE OIL TEST SPECIMEN - AFTER FOLDING

Product of Pre-coat	Coat Weight (g/m ²)	Product of Top-coat	Coat Weight (g/m ²)	Surface sealed (%)
Cartaseal® OGB F10	3	Cartaseal® SWF	4	25
	3		5	30
	5		4	95
	5		6	80

Customized Barriers barrier solutions: studying the combination of multiple coatings to improve Heat-Sealing properties:

We found the performances of Cartaseal OGB F10 to provide superior oil & grease to most existing water based solutions. However, its chemical nature affects its sealing capabilities and sealing is a needed property for many applications such as paper cups, ice cream boxes or stand up pouches.

Here, we will introduce the concept of combining Archroma's products to create a multi-purpose barrier solution.

One of the coatings developed by Archroma for heat-sealing application, Cartaseal SWF has limited grease resistance.

Therefore, we have tested the combination of those two coatings and check the effect it would have on heat sealing characteristic as well as barrier performance.

In the table above we show the results of the sealing tests done with various ratio of Archroma's Cartaseal OGB F10 over-coated with Cartaseal SWF:

Conditions:

- Dwell Time = 333ms
- Dwell Pressure = 3bars
- Temperature = 250°C
- Cooling time = 5 sec

As we can see the best combination to achieve heat sealing properties is to apply 5gsm of Cartaseal® OGB F10 and 4gsm of Cartaseal SWF as a topcoat.

While this approach demonstrates the possibility to create a heat-sealing coating, we needed to check the impact it could have on the Oil and grease performance to ensure we aren't compromising one benefit for the other.

The table below is showing the KIT performance with different combination of Cartaseal® OGB F10 and of Cartaseal SWF.

This analysis shows the initial barrier performance of Cartaseal OGB F10 is not affected by the addition of a Heat Sealable top coat such as Cartaseal SWF.

Pre-coat	Coat Weight (g/m ²)	Top-coat	Coat Weight (g/m ²)	Unfolded paper - KIT	Folded paper - KIT
Cartaseal® OGB F10	3	Cartaseal® SWF	4	16	16
	3		5	16	16
	5		4	16	16
	5		6	16	16

CONCLUSION:

Consumers and brand owners are pushing the packaging industry to develop alternative solutions to plastic with paper often serving as the default choice due to high recyclability rates and cost competitiveness. However, the low resistance to oil and grease is a natural limitation and needs to be overcome for paper to be a viable long-term solution for brands.

While the most performing barrier solution on the market are either based on PE film or fluoro based coatings, it is crucial to develop safer and more sustainable solutions in the short term.

The study we shared proved that water-based solution providing excellent barrier to oil and grease are available. Based on the partnership with many customers, Archroma knows that it is difficult to develop a single one-fit-all solution. As it has been shown in the presentation, it is often the ideal approach is to combine chemistries based on the application and performance requirements to achieve a winning solution that meets technical and market specifications.

It is necessary to develop products with minimal environmental footprint. Archroma is committed to developing barrier solution based on renewable raw material. The consumer push for this type of solutions is growing all over the world, that is why Archroma will intensify the development effort in this direction and will continue to push the boundaries and increase the share of bio based raw material in future barrier coatings.

¹Source: Smither Pira "The Future of Functional and Barrier Coatings for Paper and Board to 2028"