

Out with PFAS On with performance

Rethinking oil and grease barriers
for fibre-based food packaging





For years, fluorochemicals made oil and grease resistance look relatively simple. A small amount of chemistry could change the surface behaviour of paper and provide a high level of repellency, and it did so without asking anything of the sheet underneath. In the United States, manufacturers completed the phase-out of PFAS-containing grease-proofing substances for food-contact paper and paperboard in 2024.¹ And in Europe, the shift has moved from intention to implementation: since 12 August 2026, the Packaging and Packaging Waste Regulation has restricted PFAS above defined limits in food-contact packaging, while raising expectations around the recyclability of packaging placed on the European market.²

Regulation, though, is rarely what puts a barrier trial on the schedule. For many producers, the trigger has been more immediate than any deadline. Moving from C6 to C2 fluorochemistry has itself required a higher dosage to hold the same KIT level,³ which turned a compliance question into a cost and consistency problem well before the legislation applied. For a growing number of mills, the transition away from fluorochemical barriers is already an operational reality.

That creates a more difficult question than simply how to remove PFAS. The real question is how to remove PFAS and still make the package do what it is supposed to do — and the distinction matters, because replacing a fluorochemical barrier is rarely a one-for-one chemistry swap. Once the mechanism changes, the paper, the coating technology, the drying conditions, the coat weight and the final application all become part of the performance equation. That is where the next phase of barrier innovation begins.

Out with PFAS does not mean out with performance. But maintaining performance requires a different way of designing the barrier.

1 U.S. Food and Drug Administration. (2024, February 28). FDA announces PFAS used in grease-proofing agents for food packaging no longer being sold in the U.S. <https://www.fda.gov/food/hfp-constituent-updates/fda-announces-pfas-used-grease-proofing-agents-food-packaging-no-longer-being-sold-us>

2 European Commission. (2026, August 11). New EU rules on packaging enter into application. https://environment.ec.europa.eu/news/new-eu-rules-packaging-enter-application-2026-08-11_en

3 Royal Avebe. (n.d.). PerfectaFILM Customers Applications [Internal customer application presentation; data on file].

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The PFAS transition changes the technical rules

Paper has qualities that make it attractive for packaging: it is fibre-based, widely collected and already part of established recycling systems. It also has a basic weakness when it comes to fatty foods, which is that it is porous. Oil and grease migrate into and through the fibre structure, so for food wraps, bakery papers, dry-food boxes and other grease-loaded applications the paper needs additional functionality to do its job.

Fluorochemicals delivered that functionality very efficiently. Relatively small quantities of PFAS-based chemistry could produce a significant effect, because the mechanism worked by changing the surface behaviour of the sheet rather than by covering it. As Avebe's technical expert explains, a film-forming alternative works the other way round: it generally needs to create an actual layer on top of the paper, and that single difference explains most of the disappointment in first-generation PFAS-free trials.

The consequences run further than the coating kitchen. The paper may feel different and may look different. The required coat weight changes. And most importantly, performance becomes far more dependent on how well the coating layer is formed, which means the sheet is now part of the barrier rather than a neutral carrier for it. Removing PFAS is therefore not a raw-material substitution project. It is a barrier-design project.



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Five principles for developing a PFAS-free barrier

Moving away from fluorochemical-based barriers changes more than the chemistry. It changes the way barrier performance needs to be designed. From Avebe's work with paper manufacturers, converters and coating specialists, five principles consistently determine whether a PFAS-free oil and grease barrier succeeds in practice:

1

Start with the package, not the coating.

Define the required performance from the end use: the food, oil or fat, contact time, temperature and converting conditions.

2

The base paper is part of the barrier.

Porosity, absorbency and surface structure determine how well the coating can form a barrier film.

3

Film continuity matters more than simply adding more material.

A higher coat weight cannot compensate indefinitely for poor hold-out or defects in the surface layer.

4

The machine is part of the barrier technology.

Application method, line speed, shear and drying conditions influence how the coating is applied and how the film develops and performs.

5

Performance must be proven under real application conditions.

Laboratory screening is only the start. The final concept should be benchmarked after coating, converting and, where relevant, exposure to the actual food and use conditions.

Start with the packaging, not the coating

One of the most important lessons from Avebe's work with paper manufacturers is also one of the simplest: do not begin by asking which coating you need, but by asking what the packaging needs to do.

A bakery sheet and a fast-food wrapper may both require grease resistance, yet not necessarily for the same oil, at the same temperature, for the same contact time or at the same performance level. A sandwich wrapper may need to perform for minutes or hours, while other applications require resistance for far longer. At the extreme end of the scale sit applications such as pet-food bags, where oily contents may remain in contact with the packaging for months; Avebe's technical expert describes that as a substantially more demanding performance level than the dry-food and on-the-go applications on which PerfectaFILM® is currently focused.

This is precisely why a single headline number for grease resistance never tells the full story, and why the useful questions before developing a PFAS-free alternative are practical ones:

What product will the package contain, and which oil or fat is involved?

How long will contact last, and at what temperature?

What level of oil and grease resistance is actually needed?

Which paper is being used, and how will it be coated?

What are the demands for folding, creasing, printing and converting?

Which existing barrier is the new solution expected to replace?

A technically credible alternative begins with this application window rather than with a product datasheet. Not every package needs the same barrier; it needs the right barrier for its job.

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Why potato starch is technically interesting

Moving away from PFAS does not automatically mean moving to potato starch.

Several alternative barrier technologies are available, each with its own strengths and trade-offs. Synthetic polymer dispersions can provide strong barrier properties but remain based on synthetic, often fossil-derived chemistry, which is exactly what a growing number of customers are trying to move away from. Natural waxes can be useful where moisture resistance is required, but Avebe's development experience points to a real trade-off: grease resistance may be lower, and wax-treated papers can become more translucent or greasy in appearance and more difficult to print. Other bio-based materials, including alginates, can also form barriers, though their cost and high viscosity can make them less practical for some industrial coating systems.

Potato starch offers a different starting point.

Its relevance lies in its natural film-forming behaviour. Avebe works with the particular molecular characteristics of potato starches and has access to variants with different molecular structures, including an amylopectin-rich variant. The branched molecular structure of amylopectin, and the interactions between starch molecules, are described by Avebe's technical team as important factors in film formation — and that film-forming behaviour is what the PerfectaFILM® concept is built on.

The objective is not to put a natural ingredient onto paper, but to create a sufficiently continuous layer at the surface of the sheet so that oil and grease have a more difficult route into the fibre structure.

High molecular weight, solution stability and low paper penetration are the key technical characteristics behind PerfectaFILM®'s unique film-forming ability. Clear, colourless solutions matter for a reason that is easy to overlook in a technical discussion: an optically neutral coating protects the appearance of a white, food-facing grade. Taken together, these properties make potato starch relevant not only because of where it comes from, but because of what it can be engineered to do on the paper surface.

**“Natural origin
is a benefit.
Film formation is
the technical reason
it matters.”**



PerfectaFILM®: performance is created at the surface

PerfectaFILM® is Avebe's potato starch-based product portfolio for developing oil and grease barrier coatings for fibre-based packaging, with current focus areas including dry-food, bakery, fast-food and on-the-go applications. Its role is to help create a continuous film at the paper surface. The performance of a PerfectaFILM®-based product depends on the selected grade and formulation, the paper substrate, the application technology and process, the converting conditions and the intended end use — and that is not a disclaimer but the central technical argument of this paper, which is why everything that follows deals with the system rather than the ingredient.

Creating performance at the surface is where most of the engineering lies. The objective is to achieve sufficient hold-out and keep material where the barrier is needed. Uniformity matters more than volume for a second reason as well: barrier performance behaves as a threshold property rather than an average. A film with defects does not perform slightly less well across the sheet; it fails at the defects which is — which is how a coating that reads well on a coat-weight report can still fail.

The substrate determines how easily the coating penetrates. A porous, open or rough surface can absorb too much material. Increasing the amount of barrier chemistry is not necessarily the answer. A base paper requires minimum substrate conditions to be turned into a barrier paper, which may mean there is work to do on the base paper before optimisation of the coating begins.

The application technology determines how the coating layer is distributed and how quickly it is stabilised on the surface. Viscosity limits, shear, coat weight, line speed and drying all matter, and the application system needs to build the layer without introducing pinholes or other defects that interrupt the film. Different paper machines use different application technologies, and Avebe has developed a PerfectaFILM® portfolio to work across a broader range of those systems rather than expecting every producer to use the same product.

The coating concept is where the two come together. PerfectaFILM® provides the potato starch-based film-forming component, but the final formulation is developed around the paper, the equipment and the target. In some applications other natural materials or functional components can be combined with the starch-based platform where additional properties such as water resistance are required, which allows the barrier concept to be designed around the required functionality instead of expecting one raw material to solve every packaging challenge.

From ingredient supplier to barrier-development partner

No two papers are exactly alike, and there is no meaningful universal recipe for a PFAS-free grease barrier. That has shaped the way Avebe works: the process starts by analysing the base paper, understanding the available application technology and defining the actual performance requirement, and from there the development route moves through four stages.

In the first phase, Avebe and the customer define the target — substrate, coating equipment, intended food application, oil or fat exposure, test method, existing reference and required performance. Substrate characterisation comes first, because porosity, roughness and absorbency determine what is achievable before any formulation is chosen.

In the second phase, Avebe formulates a coating concept around the process window, with viscosity as a particular constraint since the formulation must remain compatible with the customer's application equipment.

Validation assesses the coating on the selected paper at laboratory or pilot scale, testing oil and grease performance against the agreed target rather than a generic specification and benchmarking it against the barrier currently in use rather than an abstract figure. Several industry-accepted tests serve as screening tools, including the KIT test (TAPPI T 559), Cobb method (ISO 535) and Gurley method (NEN-ISO 5636-5).⁴ Penetration and porosity methods add context, and no result means anything without its conditions stated.

Finally, in the scale phase a promising concept moves to the customer's machine, where coat weight, drying, runnability and barrier performance are optimised under industrial conditions, followed by verification after converting and, where relevant, testing with the actual food, temperature and contact time. A defined process window is what makes the result repeatable.

This collaborative approach is an important part of the development process. Avebe is not asking customers to fit their process around one fixed coating; the aim is to determine how far the platform can be adapted to their paper and their production reality.

4 Technical Association of the Pulp and Paper Industry. (2022). T 559 cm-22: Grease resistance test for paper and paperboard. <https://imisrise.tappi.org/tappi/Products/OI/T/OIO4T559.aspx?WebsiteKey=1773b35d-a94b-419b-9fd5-7f24dc9bc850>

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International Organization for Standardization. (2013). ISO 5636-5:2013: Paper and board — Determination of air permeance (medium range) — Part 5: Gurley method. <https://www.iso.org/standard/53062.html>

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Proof in practice

The two projects below illustrate different topics, and their differences matter as much as their results. One is oil and grease barrier development, another is a staged reduction rather than a replacement. Presented as a single block of proof they would mislead; presented for what each one is, they describe a platform with a clear centre and known advantages. For both, customer identity, reported values and approval for external publication are to be confirmed with Avebe technical and commercial owners before release.



Case I — Developing fluorochemical-free OGR paper

A customer developing fluorochemical-free oil and grease resistant paper evaluated a PerfectaFILM®-based concept in both laboratory and machine conditions, and the development illustrates why barrier performance cannot be judged from the raw material alone. Laboratory work using a multicoater produced significantly different add-on and performance behaviour from the production machine: according to the project data, the lab required approximately twice the add-on to reach only around 50 to 60% of the final machine performance.⁵

At production scale, on a film press, the project achieved a KIT value above 7 at a reported coat weight of approximately 1.5 to 1.8 g/m², depending on the paper produced.⁶ Additional development also explored crosslinking options where increased water resistance was required; that work is ongoing and the results are not reported here.

What the case demonstrates is that meaningful oil and grease resistance can be developed without relying on a fluorochemical barrier, but that the final result is created by the interaction between substrate, formulation and machine conditions. The machine is not simply the scale-up step — it is part of the barrier technology.

45 gsm final	Coat weight	Kit (Tappi T 559)	Gurley (s/100mL)
Base paper	-	-	150
FC treated	1.5	4	170
Lab 1	4.1	4	-
Lab 2	8.5	7	-
Mill	4.0	7	>4000

Source: Royal Avebe, Lab Trial Report IRI8.6I7 and internal machine-trial presentation. KIT measured according to TAPPI T 559 cm-22; Gurley according to ISO 5636-5:2013.

⁵ Royal Avebe. (n.d.). Lab Trial Report IRI8.6I7 [Internal laboratory trial report; data on file].

⁶ Royal Avebe. (n.d.). PerfectaFILM Customers Applications [Internal customer application presentation; machine-trial results; data on file].

Case 2 — A transition does not always need to happen in one step

Going from a conventional fluorochemical solution directly to a fundamentally different barrier mechanism can require changes in paper design, process settings and performance expectations, so for some producers a staged transition is more realistic. In one customer project, PerfectaFILM® was used in the context of a switch from C6 to C2 fluorochemistry, where the change in chemistry had resulted in a higher dosage being required to achieve the same KIT level. By introducing PerfectaFILM® into the coating concept, the customer reduced the fluorochemical component by 50% while working on the existing film-press configuration and without changing the paper support.⁷

This is a reduction result rather than a PFAS-free result, and it should not be read as a general dosage claim for other systems. Its technical significance lies elsewhere: it indicates that a starch-based film can improve the efficiency of other surface-treatment chemicals, which makes a staged route credible for an operation that cannot change everything at once. For some producers the objective will be complete elimination; for others, development will proceed through intermediate steps while the paper, coating concept and application technology are optimised. Either way, the point is to begin designing for a future in which fluorochemical performance can no longer be taken for granted.

	Fluorochemical		Kit (Tappi T 559)	
	Type	Dosage level	Top side	Back side
Size press starch	C6	100%	7	12
PerfectaFILM®	C2	50%	10	11

Source: Royal Avebe, PerfectaFILM Customers Applications [internal presentation; data on file]. KIT measured according to TAPPI T 559 cm-22.

⁷ Royal Avebe. (n.d.). PerfectaFILM Customers Applications [Internal customer application presentation; data on file].

Out with PFAS. On with a different definition of performance.

The move away from PFAS changes more than the chemistry used to make paper grease resistant. It changes the way barrier performance needs to be developed.

Start with the package, not the coating.

Treat the base paper as part of the barrier system. Focus on creating a continuous surface film rather than simply adding more material. Recognise that the application equipment and production conditions influence the final result. And prove performance under the conditions in which the package will actually be used.

Potato starch provides a technically relevant route because its molecular structure can be used to create a film at the paper surface. PerfectaFILM® builds on that functionality, while Avebe brings the application knowledge needed to connect the ingredient to the paper, process and the required end performance.

That is also where Avebe sees its role: not simply supplying another coating ingredient, but helping paper and packaging producers answer the question that comes after PFAS:

What does this package need to do, and how do we design the barrier to make that happen?

Royal Avebe — your development partner for biodegradable packaging solutions

Avebe has worked with potato starch and potato-derived ingredients for more than a century, and with PerfectaFILM® that expertise is applied to one of today's most urgent packaging challenges: developing functional, potato starch-based barrier concepts for paper and fibre-based packaging.

The first step is not necessarily a sample request but a technical conversation, in which we review your base paper, coating technology, current barrier, performance target and end-use conditions to determine whether a PerfectaFILM®-based concept is the right route for your application.

Ready to explore your PFAS-free barrier route?

Talk to an Avebe specialist about your paper, process and performance requirements.



Sources for editorial/reference use

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Royal Avebe

P.O. Box 15
9640 AA Veendam
Prins Hendrikplein 20
9641 GK Veendam
The Netherlands

E info@avebe.com

avebe.com

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since 1919