PRESCOUTER

Unlocking Billion-Dollar Opportunities

Why Thinking Outside Your Industry Is The Key

What's covered in this report

In this Intelligence Brief, we explore the power of innovation by analogy, bringing together experts from our global network to explore coating alternatives from adjacent industries. The analysis pinpoints potential solutions to address 3 pressing challenges in the Consumer Goods and Food & Beverage sectors.

CHALLENGES faced by the CPG and F&B sectors highlighted by experts	**SOLUTIONS** Abstraction and potential solutions found in adjacent industries
Food Microbial Spoilage	Can a solution for preventing biofilm formation on medical devices solve the billion dollar food spoilage problem?
Dairy Fouling	Can an innovative silicon polymer technology address the issue of fouling during dairy product manufacturing?
Non-PFAS Materials	Can a novel approach for preventing ice formation on airplane wings replace the use of PFAS-based materials in skiing and snowboarding?

EXPERT ASSESSMENT

of the feasibility of implementing the highlighted solutions

Avik Khan
Research Scientist,
Chinova Bioworks

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

Brian Babcock
President and founder, *Polymer Chemistry and Coating Technologies*

Innovation by analogy involves creatively applying ideas from one field to another, leading to unexpected solutions and new functionalities.

WHY?

Developments in digitalization, material science, climate change, and globalization in the last five years have changed the dynamics of consumer goods industry. As such, the speed of consumer interactions and their shifting preferences has increased tremendously, expecting personalized and sustainable products with improved function and faster turnaround times.

Successful product innovators will adapt their processes to adopt technologies that have emerged in other industries and encourage thinking outside of traditional boxes.

HOW?

Abstract your product functionality targets to their base chemical and physical phenomena, identify industries tackling similar challenges, benchmark potential concepts, validate the benefits of adapting to these solutions to your challenge, iterate and refine until top candidates are confirmed.

WHAT?

Innovation by analogy promotes the cross-fertilization of ideas that can lead to breakthrough innovations. By recognizing commonalities among unrelated problems, your team gains a speed-to-market advantage, reduces the risk and costs of new product development, and foster a culture of innovation.

PreScouter provides a structured methodology with unique value by leveraging teams of advanced-degree analysts and Subject Matter Experts with cross-disciplinary backgrounds who objectively evaluate our client's product innovation challenges.

Preventing Microbial Food Spoilage

Innovations in medical device coatings have the potential to address the billion-dollar food spoilage issue.

30%

LOST ANNUALLY

Microbial spoilage poses a significant global sustainability challenge, particularly in the context of fish losses. Over 30% of annual fish production is compromised due to spoilage issues in the food supply chain.

A COATING SOLUTION FROM HEALTHCARE

The TridAnt coating from BioInteractions is a promising new solution for food spoilage. The non-leaching coating resists infections, curbs biofilm, and targets a broad spectrum of bacteria. It can boost food packaging efficiency, but cost remains a consideration for F&B packaging applications.

Preventing Dairy Fouling

An innovation used in boat coatings could solve the costly problem of dairy fouling during manufacturing.

80%

OF PRODUCTION COSTS

Fouling of dairy products is a major problem for the industry, requiring periodic and rigorous cleaning-in-place procedures that use chemicals and large amounts of water. It is estimated that fouling accounts for 80% of the production costs of these products.

A COATING SOLUTION FROM THE MARINE INDUSTRY

The healthcare, automotive, and marine industries bear promising approaches potentially applicable to overcoming fouling during dairy-based food manufacturing. AkzoNobel's B-Free Explore coating is suitable for use on surfaces including aluminum and steel, and it may help to reduce the environmental burden associated with the periodic cleaning procedures used by the dairy industry. A necessary step is to identify if B-Free Explore is able to repel calcium and phosphate ions in dairy equipment.

Finding Non-PFAS Materials

An innovation in aircraft coatings could replace the PFAS-based coatings used for skiing and snowboarding.

RISING HEALTH CONCERNS

US skiers and snowboarders use PFAS-containing fluorinated waxes and solvents for equipment maintenance. The ski and snowboard sectors are adopting safety measures, considering non-fluorinated alternatives due to health concerns.

A COATING SOLUTION FROM THE AIRCRAFT INDUSTRY

A potential solution lies within the construction, automotive, and aircraft industries. A super-omniphobic coating technology developed by the Tsinghua University demonstrates liquid repellency and minimal ice adhesion forces, attributed to a specialized deposition pattern utilized on aircraft surfaces. However, the feasibility of applying this nanoparticle deposition pattern to the topsheet of skis and snowboards remains a challenge for implementation.

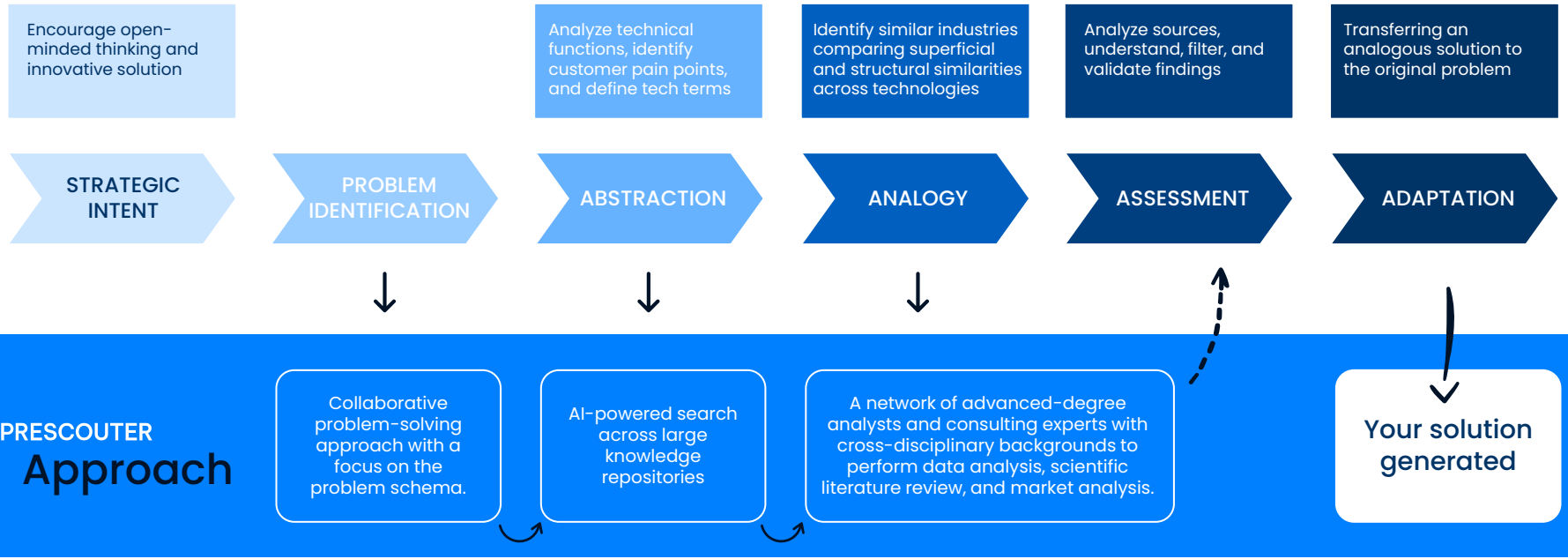
Innovation by Analogy

How can solutions from adjacent industries be applied to current challenges in your industry?

Abstracting your specific challenges can unlock a multi-faceted value proposition and transformative ideas. Below are three exemplary cases:

	Pain Point	Analogy	Value Add
Baby Buggy meets **aeronautics** [1]	Heavy and large strollers made carrying babies around hard and inconvenient.	Drawing from aviation design: Use lightweight aluminum rods, sturdy triangular structures for reinforcement, and twin landing gear wheels.	The Maclaren B-01 baby buggy, introduced in 1967, marked as the world's first and most popular stroller, maintaining its status as a benchmark product to this day.
BMW's iDrive meets **video game** industry [2]	The need of 200 buttons and switches in the dashboard of luxury BMW cars to achieve all desired functions.	Mimic the intuitive control of a video game joystick, ensuring functions are executed seamlessly and effortlessly.	Innovation launched in 2001 that brought a totally intuitive user experience that is still used in BMW cars today.
Salesforce meets the utilities & airport industries [3]	Substantial upfront investments in hardware, software licenses and IT infrastructure with high maintenance costs.	Salesforce found inspiration in diverse sectors on its journey, including service (on-demand delivery), airport check-in kiosks (event self-service points), and the music industry (street teams for launches and campaigns).	Introduced a revolutionary approach by providing cloud-based, self-maintaining CRM as a service. Salesforce stands as one of today's most widely used CRMs and has maintained the #1 position in CRM market share for the past 9 years.

Identifying analogical innovation process



Innovation by Analogy

In action

WE ASKED EXPERTS:

If you had no budget restrictions, what's one challenge would you love to solve in your industry?

Presented are the top three items on their "wishlist" of challenges to overcome.

Three of the biggest challenges facing the F&B and consumer goods industry are:

1

Food Microbial Spoilage

Microbial spoilage is a global sustainability issue and the main driver of fish losses. More than 30% of total fish production is lost each year due to these problems in the food supply chain.

2

Dairy Fouling During Manufacture

Fouling of dairy products in the dairy industry requires periodic and rigorous cleaning-in-place (CIP) procedures that use chemicals and large amounts of water. It is estimated that 80% of the production costs of dairy products are due to fouling during manufacture.

3

Non-PFAS Materials To Generate Self-Cleaning Properties

The use of fluorinated waxes and solvents by skiers and snowboarders in the United States is a cause for concern due to the potential health and environmental risks posed by these chemicals.

Preventing Microbial Spoilage in Seafood

> The biggest challenge that can be solved by an improved coating or additive composition is reducing food waste caused by microbial spoilage and thereby increasing the shelf-life of the product.

Avik Khan
Research Scientist, *Chinova Bioworks*

Microbial spoilage is a major driver of fish losses, accounting for more than 30% of total fish production each year.

Microbial spoilage is a global sustainability issue and the primary factor behind fish losses. It can have a considerable financial impact, with over 30% of total fish production lost each year due to problems in the food supply chain [2].

Conventional seafood coatings are mainly based on polyethylene for its transparency, flexibility, and water resistance. However, it does not have any inherent antimicrobial properties [3].

Modified atmosphere packaging (MAP) is a well-known strategy for maintaining a reasonable shelf life of seafood. The protective action of MAP varies depending on the food's fat content, species, and initial microbial load, which will determine the most suitable gas mixture [4].

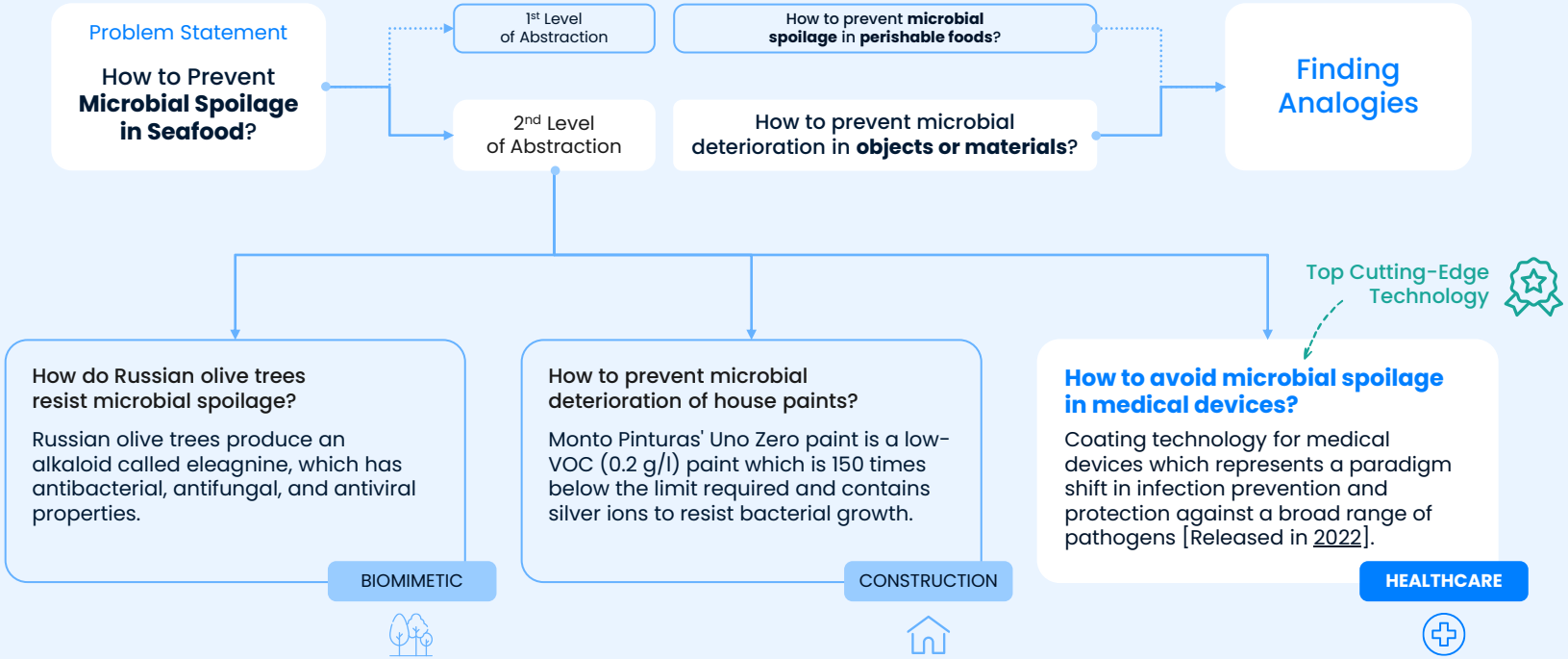
Researchers are committed to developing strategies based on antimicrobial coatings to further extend the shelf life of seafood, either in combination with MAP [5] or as an independent method [6].

The concern with prolonging the shelf life of seafood is further intensified by new trends that focus on reducing synthetic preservatives, which requires innovation and the application of additional strategies [7].

Fresh seafood is highly perishable and can spoil quickly due to the high water activity and high water content (75-85%) that makes it susceptible to microbial growth [1].

One-third of all food produced globally by weight is lost or wasted between harvest and final consumption [2]. Food spoilage caused by spoilage microorganisms during storage and distribution has a major impact on food quality and shelf life [3].

Abstraction to General Questions, the moment to look for the underlying patterns and principles: ***How can I increase the shelf life of packaged seafood?***



TridAnt Coating:
From Healthcare to Food & Beverage

HEALTHCARE

INDUSTRY SPECIFIC QUESTIONS

How to avoid Microbial Spoilage in medical devices?

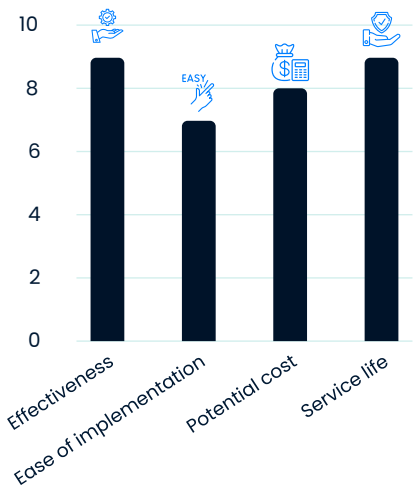
TridAnt coating technology, by BioInteractions, is a non-toxic, eluting-free coating that can eliminate viruses, bacteria, and prevent biofilm formation for up to 365 days. It has been independently tested to international standards (ISO, EN, PAS) and claimed to be suitable for a variety of surfaces, including fabrics, non-wovens, metals, and polymers (polycarbonate and polyurethanes)[1].

APPLICABILITY TO FOOD & BEVERAGE CHALLENGE

TridAnt coating technology can be used to produce films or packaging for seafood. Its extensive antimicrobial action can kill harmful bacteria and prevent spoilage, providing a superior benefit over current options. The coating's suitability for a variety of materials makes it a good choice for food packaging, with the only need to test if it can be incorporated into existing processes.

Expert Assessment of the Technology

How achievable can it be to apply this technology to solve the specific challenge in the Food and Beverage industry.



Scale: 1 indicates a performance that is far below the current benchmarks, and 10 indicates a performance that is far above the current benchmarks.

> This coating has the potential to be a highly effective antimicrobial agent for food packaging materials. It is non-leaching, which means that it will not contaminate the food, and it has a wide range of antimicrobial activity.

Avik Khan
Research Scientist, Chinova Bioworks

Preventing Fouling During Dairy-Based Food Manufacturing

> Antifouling coatings for dairy and other food products have recently gained traction among researchers around the world as a way to eliminate the adhesion of food residues. This has a number of benefits, including increased production yield, reduced cleaning costs, improved equipment productivity, reduced cross-contamination, and reduced food waste.

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

Incrustation and cleaning can account for up to 80% of the total costs of dairy-based food production.

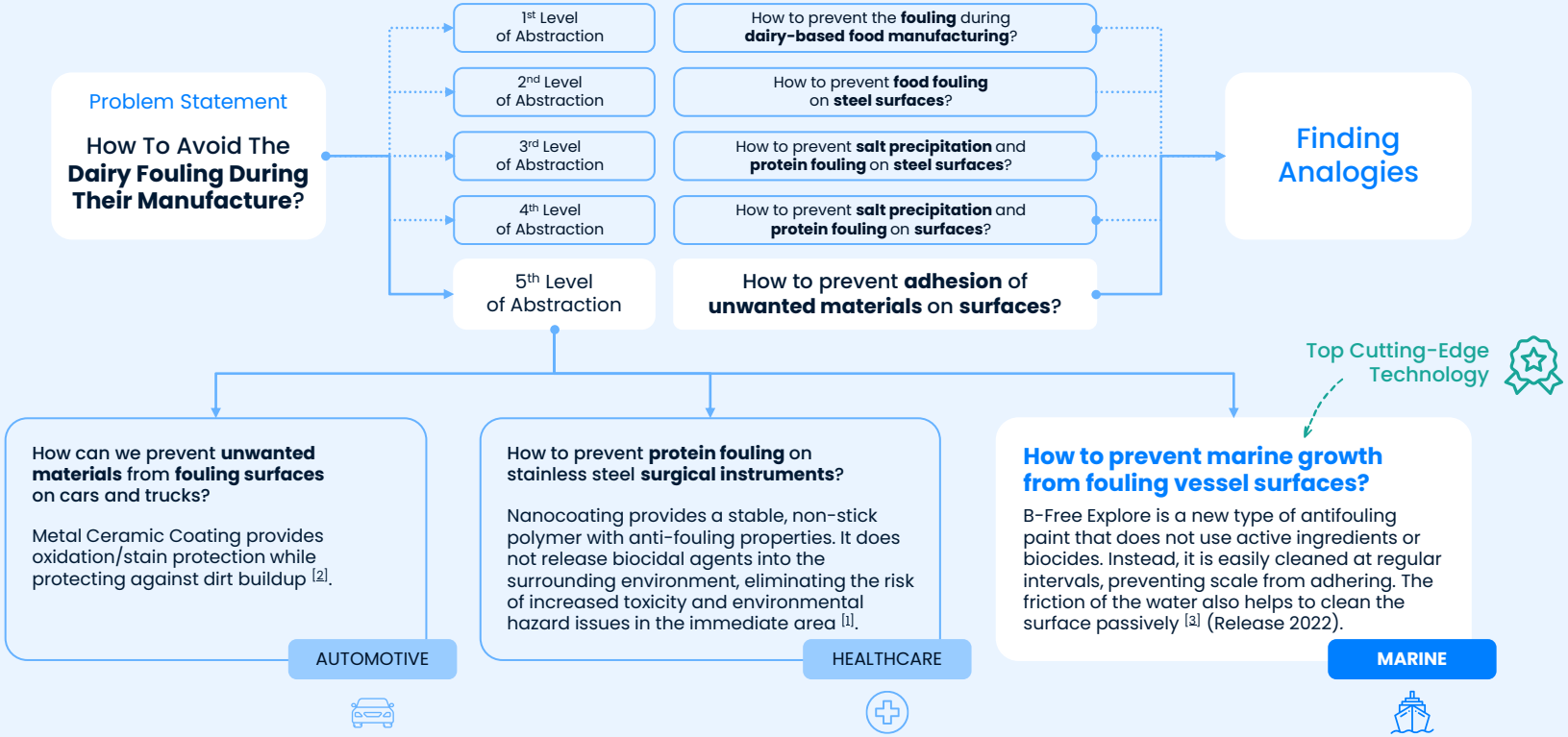
Protein denaturation and salt precipitation during thermal processes in dairy production lines can lead to fouling deposits on equipment surfaces. These deposits can harm heat transfer mechanisms, create thermal resistance, and lead to regular shutdowns for cleaning. They can also form sites prone to the formation of bacterial biofilms if not adequately removed. This is a major issue for food processing industries [1].

Fouling resistant or antifouling coatings have been proposed as a solution to dairy fouling for some time. However, additional fabrication and installation costs must also be considered, along with their fouling and cleaning performance. Therefore, the need to develop or identify cost-effective and easy-to-install coatings becomes evident [2].

The periodic and rigorous cleaning procedures required to remove fouling from dairy products are associated with high costs and environmental impacts, as they involve the use of chemicals and large amounts of water.

It is estimated that 80% of the production costs of these products are due to fouling and cleaning during manufacture [3].

Abstraction to General Questions, the moment to look for the underlying patterns and principles: ***How to prevent the fouling during dairy-based food manufacturing?***



AkzoNobel-B-Free Explore: From Marine to Food & Beverage

INDUSTRY SPECIFIC QUESTIONS

How to prevent marine growth from fouling vessel surfaces?

AkzoNobel

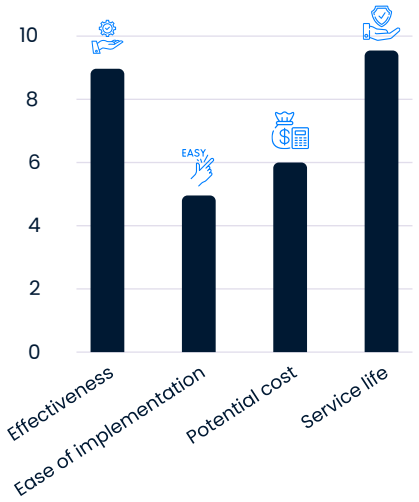
AkzoNobel - B-Free Explore is a silicone polymer antifouling coating that is easy to clean and does not contain any active ingredients. It is compatible with a variety of surfaces, including aluminum, glass reinforced plastic, and steel.

APPLICABILITY TO FOOD & BEVERAGE CHALLENGE

The application of B-Free Explore in dairy processing lines to mitigate dairy fouling is promising. The coating's suitability for steel and its ability to be applied over existing coatings may reduce the barriers to implementation. The potential to reduce fouling and facilitate cleaning (as suggested by its original application by water rubbing) could contribute to reducing the environmental burden of periodic and harsh cleaning-in-place procedures used by the dairy industry.

Expert Assessment of the Technology

How achievable can it be to apply this technology to solve the specific challenge in the Food and Beverage industry.



Scale: 1 indicates a performance that is far below the current benchmarks, and 10 indicates a performance that is far above the current benchmarks.

> This technology is very promising for fouling prevention because it dramatically reduces the surface tension and interaction of coated steel equipment. This in turn improves antifouling activity against organic and inorganic molecules. However, further work is needed to identify if B-Free Explore is able to repel calcium and phosphate ions in dairy equipment. These salts can create a strong calcium phosphate complex and deposition occurs due to pH gradients in the dairy environment.

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

Expert Notes

Marine to Food & Beverage

Applying antifouling coatings to dairy production

Potential advantages over benchmarks

B-Free Explore was proposed to prevent fouling organisms such as barnacles, worms, and mussels from forming a strong bond with the surface of the hull and boats, this can be effective and promising candidate for the food and dairy industry to reduce the friction and adhesion of proteins and undesirable deposits on the surface of stainless steel walls or pipes. Due to the new silicone polymer chemistry involved in this technology, it is expected to perform well dairy proteins, bacteria, and calcium phosphate deposition.

Research and product development from AkzoNobel or other leading companies are required to study the feasibility of such chemistry on dairy processing equipment. It is important to note that they do not have similar antifouling properties compared to fluoro-polysiloxane and fluoropolymers due to their much higher surface energy. However, due to the recent regulation against fluoropolymer free coatings for different coating applications, B-Free Explore coatings are very promising and can have a great market.

Potential Drawbacks

Complicated designs of diary equipment result in sophisticated and time-consuming implementation of coating application such as B-Free Explore. There might be two main drawbacks of application of this technology for dairy equipment: **1- lack of accessibility to the inner area of pipes**, tubes and bends to apply a uniform coating of B-Free Explore, oppose to marine sectors where coating is much easier to integrate, **2- the necessity of primer coating** to make a better adhesion of B-Free Explore.

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

How to replace the use of per and polyfluoroalkyl (PFAS) in skiing and snowboarding?

> The majority of the oleophobic and superomniphobic coatings materials are based on fluorocarbons (PFAS). There are no better materials yet to replace these compounds with similar properties.

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

Most skiers and snowboarders in the US apply fluorinated waxes that contain PFAS to their equipment and use solvents to clean the base of the ski.

In skiing and snowboarding, wax is a crucial lubrication tool that helps reduce friction between the base of the skis or snowboard and the snow. This in turn allows skiers and snowboarders to glide effortlessly and smoothly down the slopes, enhancing their experience [1].

A survey of 569 members of the US ski and snowboard community, including people who engaged directly and indirectly in recreational or professional cross-country and downhill skiing or snowboarding, found that about 92% of respondents reported using some form of wax.

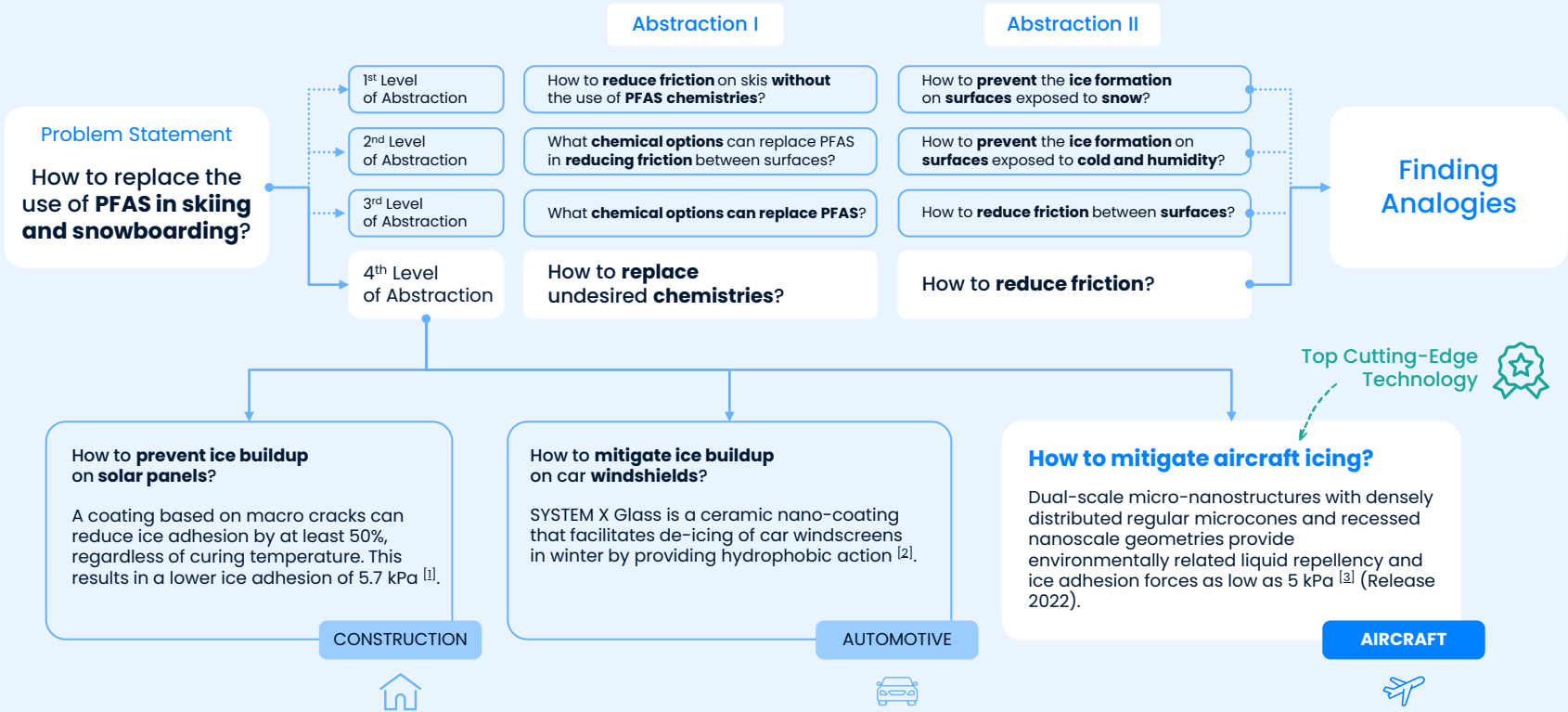
Of this group, 67% used waxes that contained PFAS chemicals, while 62% also used solvents for ski base cleaning. Wax was most commonly used among cross-country skiers, followed by downhill skiers and then snowboarders [2].

Known as “forever chemicals”, PFAS chemicals are difficult to break down because of their strong carbon-fluorine bonds, which makes them persist in the environment and in living organisms, including humans. This can lead to a buildup of these chemicals over time, which has been linked to various health effects, including altered immune and thyroid function, adverse reproductive and developmental outcomes, and cancer [3].

This highlights the need for alternative coatings that may have comparable properties to reduce ski friction with snow while also not requiring the use of hazardous solvents to clean equipment.

The famous ski town of Park City, Utah, recently banned fluorinated wax after PFAS were found in groundwater wells [3].

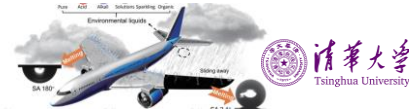
Abstraction to General Questions, the moment to look for the underlying patterns and principles: ***How to reduce the friction of snow sports equipment without the use of PFAS?***



Superomniphobic coatings: From Aircraft to Consumer Goods.

INDUSTRY SPECIFIC QUESTIONS

How to prevent marine growth from fouling vessel surfaces?



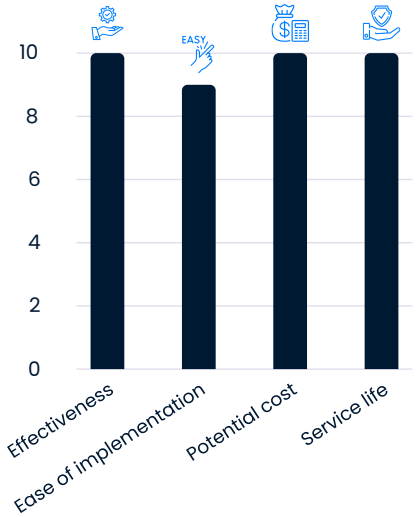
Dual-scale micro-nanostructures with densely distributed regular microcones and recessed nanoscale geometries provide environmentally related liquid repellency and ice adhesion forces as low as 5 kPa [1].

APPLICABILITY TO CPG CHALLENGE

Applying coatings with this technology to skis and boards can mitigate friction between the base of the skis and the snow due to their anti-icing properties. Additionally, the liquid repellency can impart self-cleaning capabilities, which might extend the life of the skis by eliminating the need for wax application and subsequent solvent removal.

Expert Assessment of the Technology

How achievable can it be to apply this technology to solve the specific challenge in the Food and Beverage industry.



Scale: 1 indicates a performance that is far below the current benchmarks, and 10 indicates a performance that is far above the current benchmarks.

> This technology was originally used on aviation aluminum alloys. However, the topsheets of snowboards and skis are typically made from nylon, wood, fiberglass, aluminum, or composites. Due to their different chemical, mechanical, and physical properties, studies should be conducted to determine if a combination of mechanical ablation, plasma exposure, and nanoparticle deposition can be used on these substrates.

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

Expert Insights

The potential advantages of superomniphobic coatings over benchmarks on the topsheet of snowboards and skis.

This type of coating ideally could provide high resistance to wetting or staining and possible self-cleaning capabilities. Microstructured surfaces can also enhance the performance of hydrophobic coatings, which could narrow the gap between alternate chemistries and current fluoropolymer chemistry coatings.

Brian Babcock
President and founder
Polymer Chemistry and Coating Technologies

Surface treatments with mechanical ablation combined with plasma and nanoparticle depositions are very effective methods for deicing skis and snowboards. In addition, mechanical ablation and plasma etching methods provide very environmentally friendly and clean procedures when compared with other etching methods such as chemical oxidation.

Mazeyar Parvinzadeh Gashti
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

Expert Insights

POTENTIAL DRAWBACKS

Two major drawbacks of mechanical, laser and plasma surface treatments are the scale-up and automation procedures. They have not been widely commercialized for implication in skiing products. To produce substrates with nanosized/microsized roughness and functionalities, a highly controlled process should be performed.

Furthermore they might interfere with printing and pattern fabrication as the final stages of production. Anytype of additional printing might mask off the nanoparticle substrate which in turn reduces deicing properties. The potential costs if this technology can be much higher than common lubricative materials for skiing and snowboard applications. This is due to the fact that multiple processes are involved including mechanical ablation (etching), plasma process and nanoparticle deposition.

Avik Khan
Director of Research and Development
GTI Chemical Solutions & Lab Services Inc.

About the Authors

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Technical Director

Daniel is the Technical Director for PreScouter's consumer goods practice. He has led over 100 projects, spanning across areas such as innovation strategy and road mapping, product and process improvement and development, sustainability, and technology trends throughout the CPG industry.

Daniel earned his Ph.D. in Chemical Engineering from NC State University, where his research focused on developing stimuli-responsive polymer networks for microrobotics applications. After his graduate studies, he completed postdoctoral work at INSA Toulouse, France where his work focused on the intersection of nanoparticle assembly, nanofabrication, and microfluidics to develop novel sensors. Before joining PreScouter, Daniel gained industrial experience in pharma manufacturing, polymer processing, and science manuscript editing. He is based in Raleigh, North Carolina.

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Ezequiel is a Project Architect at PreScouter working in the Consumer Goods and Healthcare verticals. He is a Pharmacist by training (Federal University of Alfenas, Brazil) and received his Master's degree in Immunology and Biochemistry at the Federal University of Minas Gerais, Brazil. Ezequiel has a research background in vaccinology and virology. At PreScouter, he has been supporting initiatives for the development of new technologies and product differentiation across the CPG and Healthcare industries.

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