



TECHNICAL INFORMATION

BYK ADDITIVE WORLD WITHOUT PFAS



Contents

- 03** Introduction
- 04** Background of PFAS concerns
- 05** Where do you find PFAS in additives
- 06** Defoamers and air release additives
- 09** Surface additives
- 11** Wax additives
- 15** Processing additives

Introduction

Per- and polyfluoroalkyl substances (PFAS) are extremely persistent, bioaccumulative, partially toxic, but widely used. In general, they show exceptional water- and oil-repellent properties, a high durability under extreme conditions, and electrical and thermal insulation. Their (formerly) unique properties include numerous applications, such as:

- Strong reduction of surface tension
- Superb substrate wetting and spreading properties
- Anti-crater properties
- Easy to re-coat
- Good leveling properties
- Non-stick properties
- Can stabilize foam (in case of fluoro-surfactants)
- Can be a very effective defoamer (in case of fluorinated defoamers)
- Anti-fingerprint properties
- Excellent abrasion resistance (in case of PTFE-based wax additives)
- Scratch resistance (in case of PTFE-based wax additives)
- Oleophobic and hydrophobic properties

BYK has invented products that cover these formerly unique properties without using PFAS.

Note

To ensure the best appearance and full functionality, please open in Adobe Acrobat.

Background of PFAS concerns

They are known to be extremely persistent, which means they will not degrade easily. Some refer to them as “forever chemicals”. In addition, they are bioaccumulative, meaning that they will accumulate via the food chain and enrich in the human body over time.

PFAS can be found today in



Rainwear, textiles, and surface treatments



Non-stick coatings for frying pans and pots, and food packaging

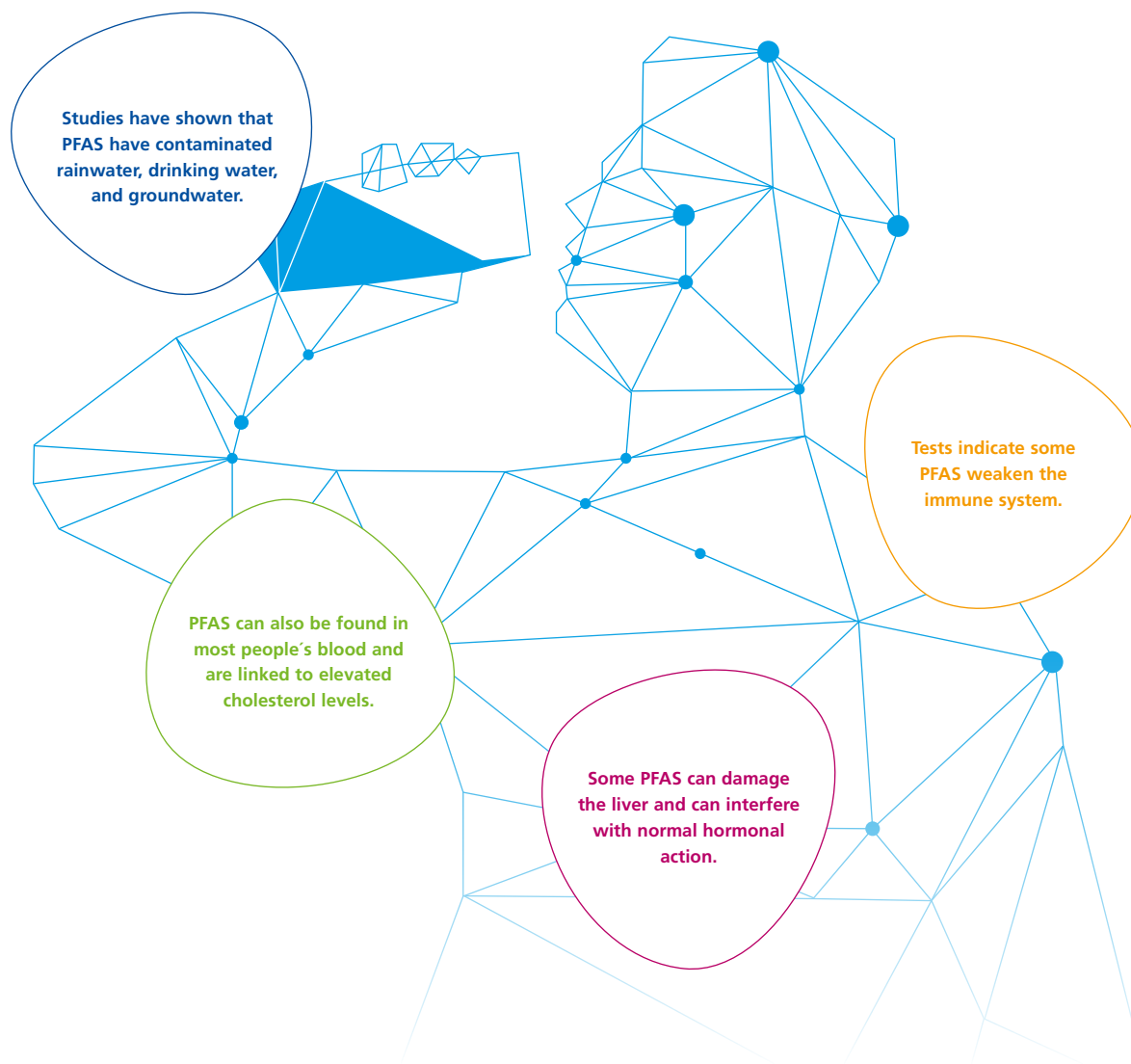


Chrome plating, paints, and construction materials



Fire-fighting foams and fire protective clothing

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Where do you find PFAS in additives



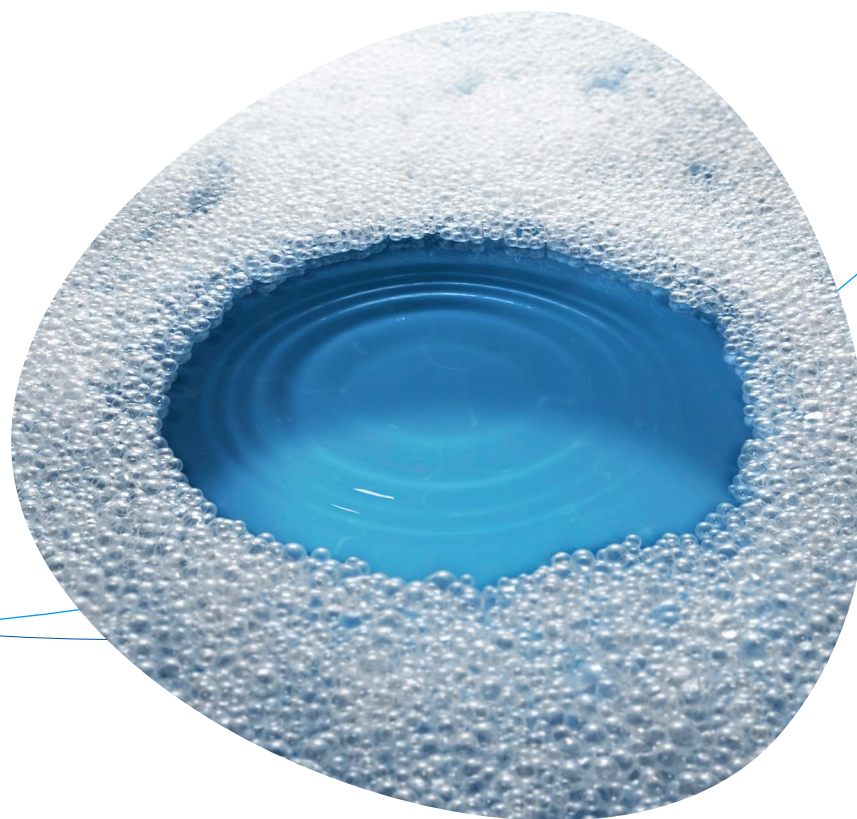
Defoamers and air release additives

The key properties of PFAS-containing defoamers and air release additives are:

- Excellent defoaming properties in a wide range of systems
- Anti-pinhole effect
- Reduction of surface tension
- Positive influence on leveling and surface appearance
- No negative influence on transparency
- Excellent storage stability

BYK products in this area include the BYK-060 family*¹ and BYK-1798.

All the aforementioned properties can also be covered by BYK additives without PFAS depending on the system used.



*¹ BYK-061, BYK-065, BYK-066 N, BYK-067 A

Selection guideline for PFAS-free defoamers

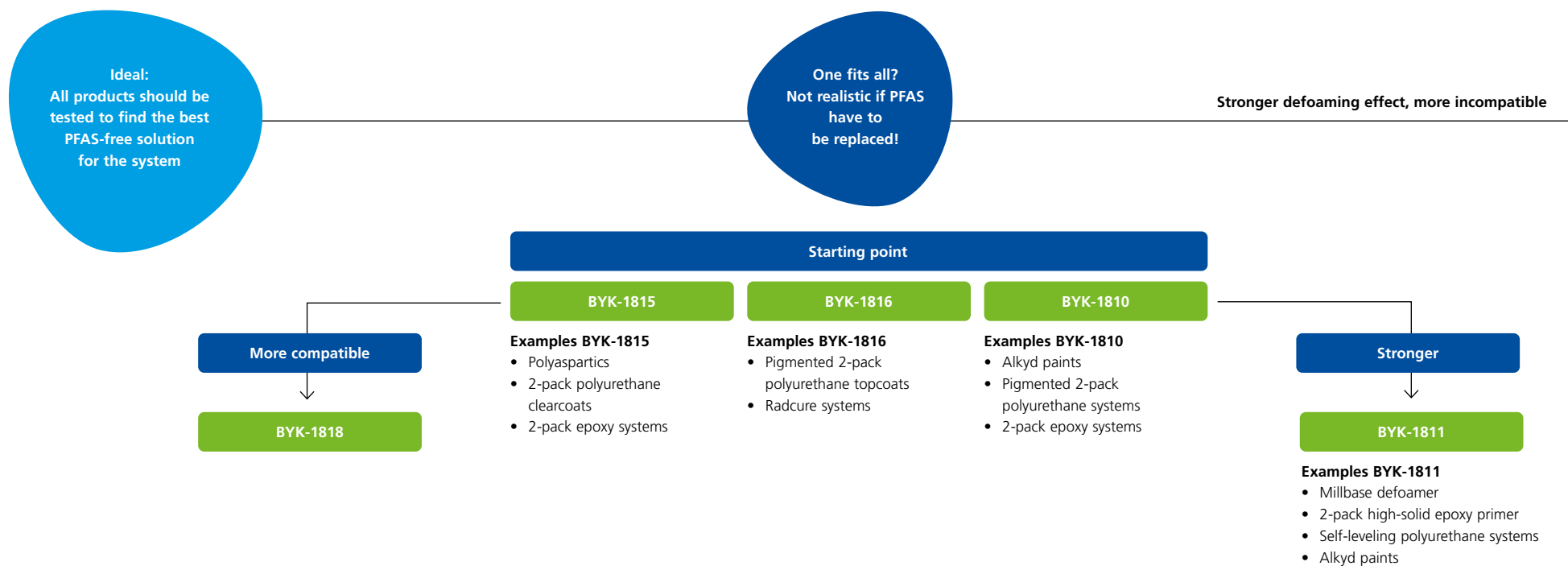
This short selection guideline for PFAS-free defoamers, especially for alternatives to the BYK-060 family, should help in the selection of the right additive or where to start. The new PFAS-free alternatives are globally available and are recommended for all application areas. To find the best PFAS-free solution for a specific system, an ideal approach is

to test each product beforehand. Nevertheless, BYK-1815, BYK-1816, and BYK-1810 make effective starting points. They achieve very good results across all application areas.

If all three products show good defoaming properties, but also display some side effects, such as cratering or turbidity, it is recommended that the more compatible defoamer BYK-1818 be tested.

If BYK-1815, BYK-1816, and BYK-1810 do not show a sufficient defoaming effect and a stronger defoamer is needed, BYK-1811 is the choice to go with. It is a very strong defoamer and therefore especially recommended as a millbase defoamer or for self-leveling PU systems.

Alternatives for the BYK-060 "family"



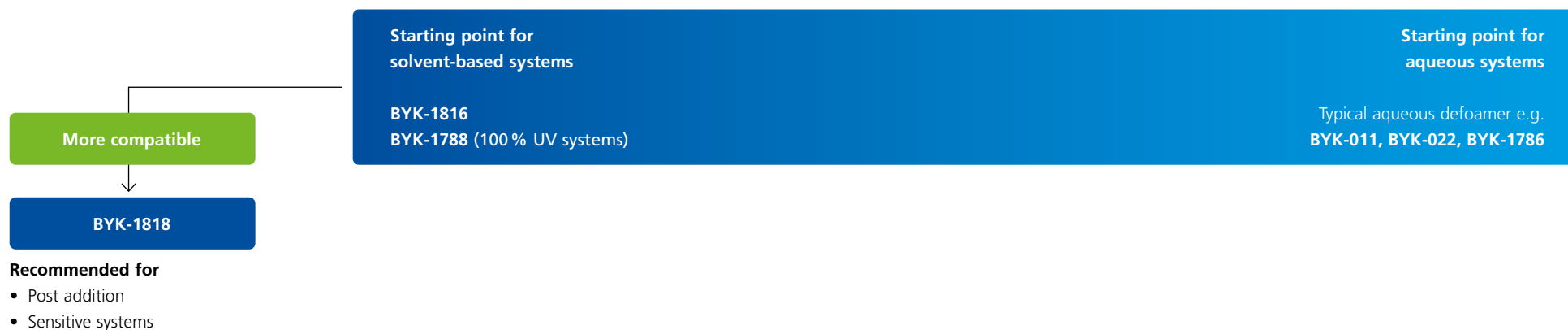
Besides the BYK-060 family, BYK-1798 is also a defoamer that contains PFAS and is also facing increased regulation. It is a very effective defoamer for water- and solvent-based systems as well as for UV systems.

Beside PFAS, it also contains butyl glycol, which is classified as toxic for inhalation as of December 1, 2023. Furthermore, it contains cumene at a concentration greater than 0.1 %, which comes from white spirit and is classified as carcinogenic as of December 1, 2023.

BYK provides innovative alternatives in preparation for the future. As with the BYK-060 family, a selection guideline for alternatives to BYK-1798 is provided here.

Depending on the system, different products are recommended as starting points. A more compatible option for post addition or sensitive systems is BYK-1818.

Alternatives for BYK-1798: an universal defoamer for all types of systems



Surface additives

The key properties of PFAS-containing surface additives are:

- Excellent compatibility in a wide range of systems
- Silicone free
- Excellent leveling properties
- Reduction of surface tension
- Effective wetting of critical substrates
- Anti-cratering properties

The BYK products in this area are BYK-3440, BYK-3441, and BYK-388. PFAS-free solutions depend on the application, the silicone tolerance, the system itself, and the desired properties.

PFAS-free recommendations for BYK-388, BYK-3440, and BYK-3441

BYK-388

Recommended for
solvent-based systems

BYK-3440

Recommended for
water- and solvent-based systems

BYK-3441

Recommended for
water-based systems

Alternative options

Polyacrylate

Leveling:
BYK-350, BYK-361 N, BYK-397

Polymer

Substrate wetting, silicone free:
BYK-399

Polysiloxane

Moderate substrate wetting:
BYK-3741, BYK-3752

Polyacrylate or polymer

Water-based systems: BYK-381
Solvent-based systems: BYK-399

Silicone-free surfactant

Water- and solvent-based systems:
BYK-3410

Polysiloxane

Water- and solvent-based systems:
BYK-333, BYK-3760, BYK-3765

Macromer chemistry

Solvent-based systems:
BYK-3568 (contains silicone)

Silicone surfactant

Substrate wetting:
BYK-3450, BYK-3451, BYK-347

Silicone surfactant

Substrate wetting, leveling:
BYK-349, BYK-3455

Polyacrylate

Leveling:
BYK-381



BYK alternatives for PFAS-containing surface additives

| Purpose/function | Solvent-based/solvent-free systems | Radcure systems | Water-based systems |
|---|--|--|---|
| Surface tension reduction (static), substrate wetting, anti-cratering, low COF | Silicone: BYK-333 BYK-3760 BYK-3762 BYK-3764 BYK-L 9565* BYK-L 9568* | Silicone: BYK-379 BYK-3760 BYK-3764 | Silicone: BYK-347* BYK-3450* BYK-3451* |
| Leveling, recoatability | Silicone: BYK-320 BYK-3550 BYK-3740 BYK-3741 BYK-3753 BYK-3762 Silicone-free: BYK-354 BYK-361 N BYK-397 BYK-399 BYK-3550 | Silicone: BYK-3753 BYK-3762 Silicone-free: BYK-350 BYK-361 N BYK-399 | Silicone: BYK-349 BYK-3450 BYK-3451 BYK-3455 Silicone-free: BYK-381 BYK-3410 BYK-3560 BYKETOL-AQ |
| Water/oil repellency, anti-fouling, anti-fingerprint, tape release | Silicone: BYK-333 BYK-3760 BYK-SILCLEAN 3700 BYK-UV 3505 | Silicone: BYK-379 BYK-3760 BYK-3764 BYK-UV 3505 | Silicone: BYK-333 BYK-3760 BYK-UV 3505 |
| Surface tension reduction (dynamic) | Silicone: BYK-379 | Silicone: BYK-379 | Silicone-free: BYK-3410 BYK-DYNWET 800 |

* Water surface tension can be reduced to less than 20 mN/m

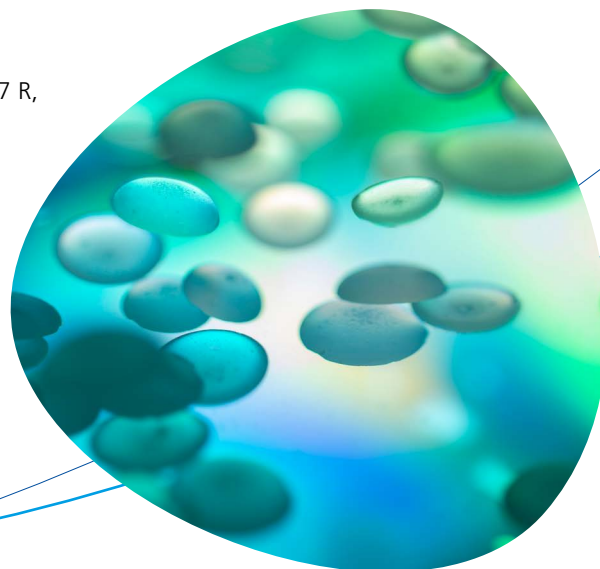
Wax additives

The key properties of PTFE-based wax additives are:

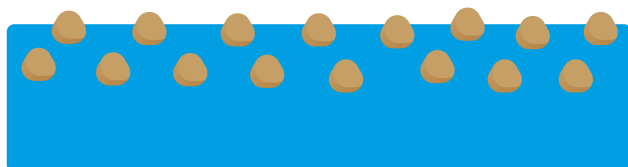
- Very good abrasion resistance
- Chemically inert
- Temperature resistant
- Higher density compared to other wax additives and therefore different orientation in the coating film

It is difficult to match all these properties exactly with PTFE-free additives, so the focus is set on **abrasion resistance**.

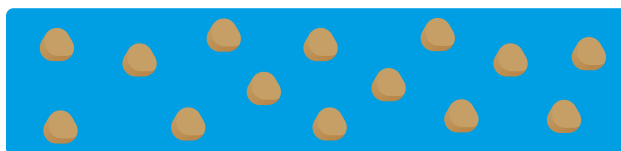
Typical PTFE-based products from BYK are
AQUACER 1550 R, CERACOL 603, CERACOL 607 R,
CERAFLOUR 955, CERAFLOUR 959, CERAFLOUR 965,
CERAFLOUR 966, CERAFLOUR 968, CERAFLOUR 969,
CERAFLOUR 981 R, CERAFLOUR 996 R, CERAFLOUR 997 R,
CERAFLOUR 998 R, CERAFLOUR 999.



PTFE-based wax additives
show a special behavior in the coating film:



Most wax additives:
Orientation to the paint surface



PTFE:
Orientation throughout the coating film

BYK alternatives for micronized PTFE-based wax additives

Recommendations for liquid coatings

| Purpose/function | Solvent-based system | Solvent-free system | Water-based systems |
|---|--|--|--|
| Abrasion resistance, scratch resistance | CERAFLOUR 925 N CERAFLOUR 929 N CERAFLOUR 988 CERAFLOUR 991 CERAFLOUR 1050 CERAFLOUR 1051 CERAFLOUR 1052 | CERAFLOUR 925 N CERAFLOUR 929 N CERAFLOUR 988 CERAFLOUR 991 CERAFLOUR 1050 CERAFLOUR 1051 CERAFLOUR 1052 | AQUAMAT 272 N CERAFLOUR 925 N CERAFLOUR 927 N CERAFLOUR 929 N CERAFLOUR 1050 CERAFLOUR 1051 CERAFLOUR 1052 |
| Scuff resistance | | | CERAFLOUR 1051 |

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Recommendations for powder coatings

| Purpose/function | Hybrid system | HAA system | Other systems |
|--------------------|--|--|----------------------------------|
| Texture | CLAYTONE-HY ● CLAYTONE-40 ○ CLAYTONE-APA ○ GARMITE-1210 ○ | GARAMITE-1210 ● GARAMITE-1958 ○ GARAMITE-7305 ○ CLAYTONE-HY ○ | CLAYTONE-HY ● GARAMITE-1210 ● |
| Scratch resistance | BYK-3932 P ● | BYK-3932 P ● | BYK-3932 P ● |

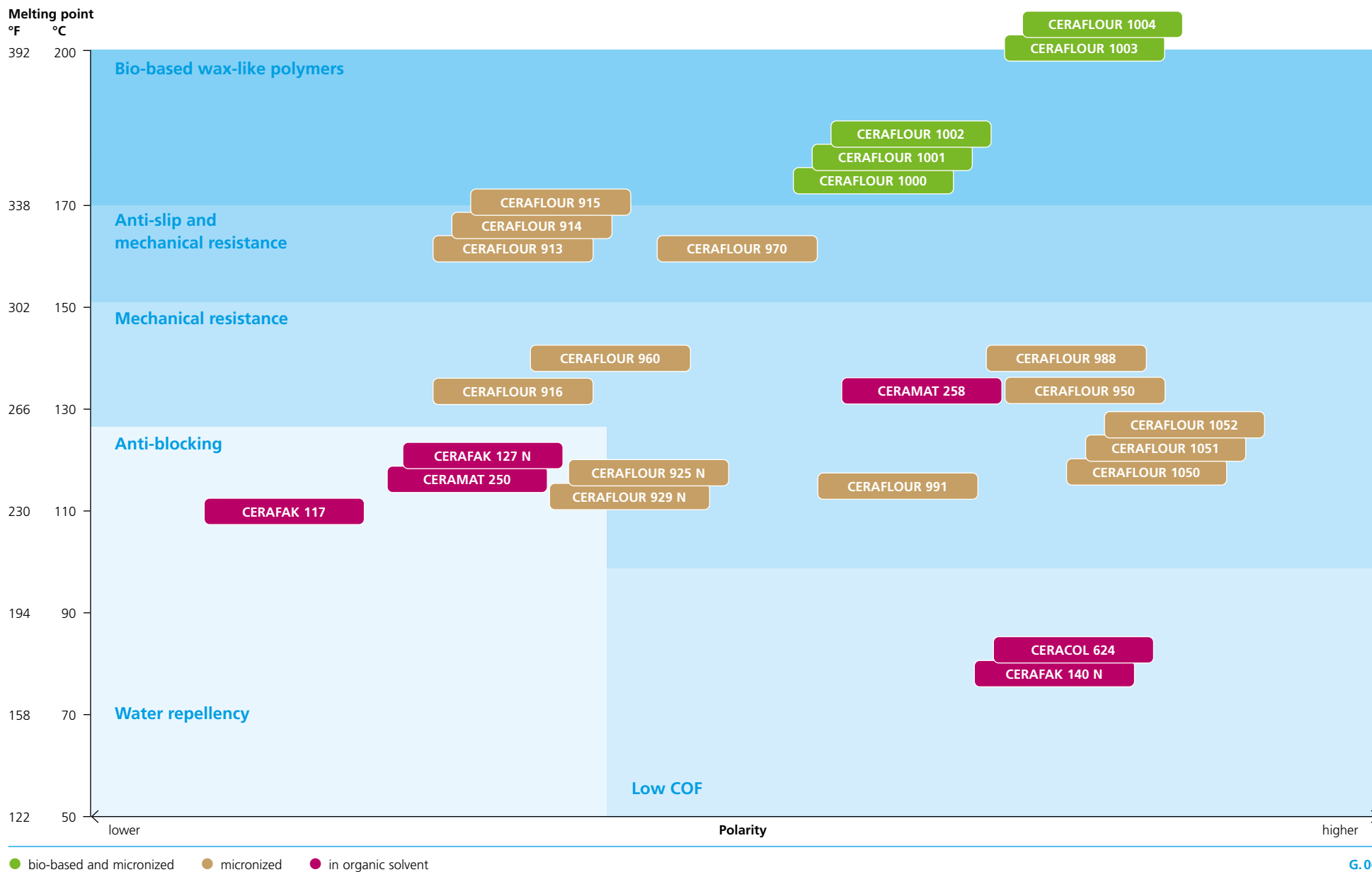
● First recommendation ○ Second recommendation

Hybrid system: Combination polyester and epoxy

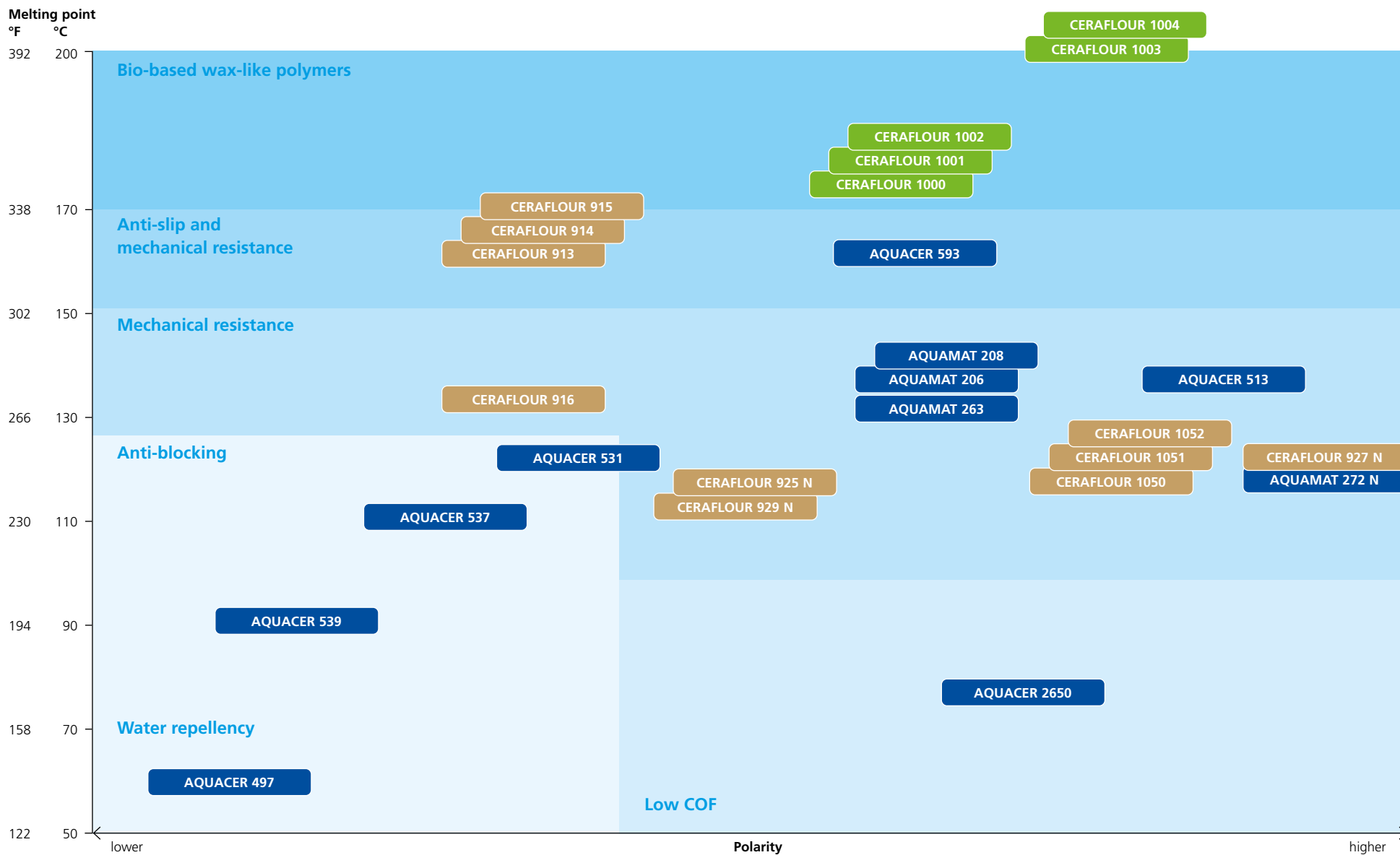
HAA system: Combination polyester and β-Hydroxyalkylamid

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PTFE-free wax additives for solvent-based systems



PTFE-free wax additives for water-based systems



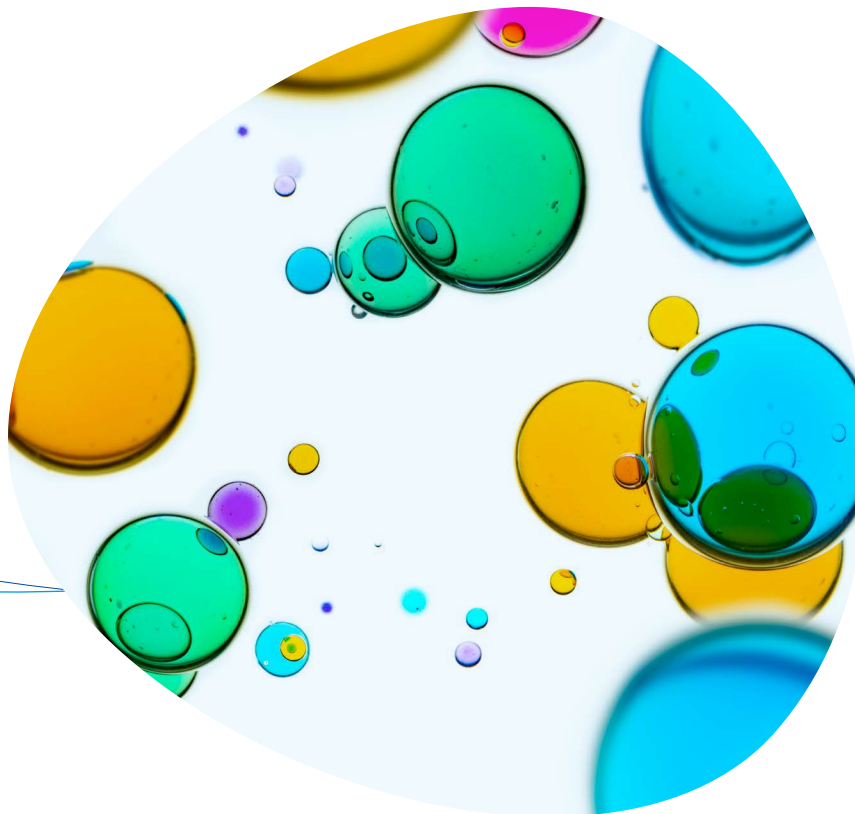
Processing additives

The key properties of PFAS-containing processing additives used in thermoplastic applications are:

- Prevention of melt fracture (sharkskin) and die build-up
- No negative influence on printability or painting
- Durable for high temperature processes up to 290 °C

A typical PFAS-containing product from BYK in this area is **BYK-MAX P 4104**.

PFAS-free alternatives depend on the application, the system itself, and the desired properties. As a replacement for **BYK-MAX P 4104**, the new processing additives **BYK-MAX-P 4109** and **BYK-MAX P 4110** can be used in polyolefins for applications such as films, fibers, sheets produced via extrusion, blow, injection, and compression molding.





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