TAPPI INTERNATIONAL FLEXIBLE PACKAGING & EXTRUSION DIVISION
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Baerolub™ AID

PFAS-free PPA Replacement

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Market Development Director
Special Additives
Baerlocher USA

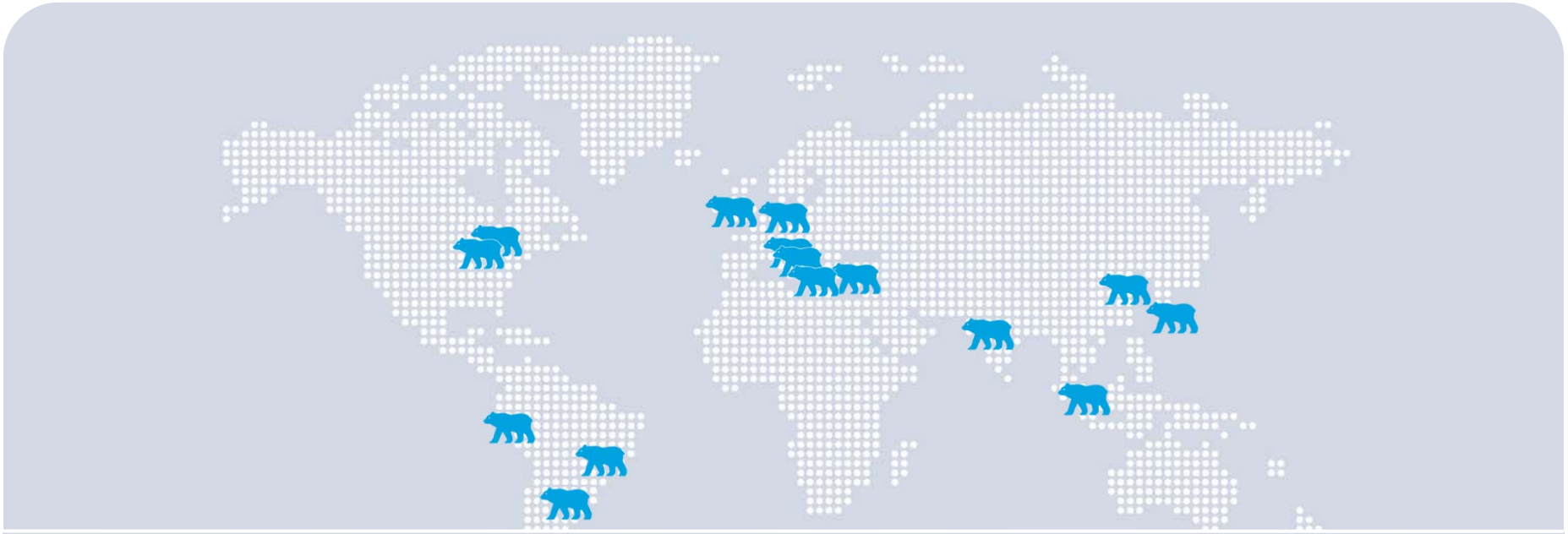
Company | Global Partner

Your global partner for additives

Baerlocher Group of Companies serves local customer needs with innovative / customer tailored solutions.

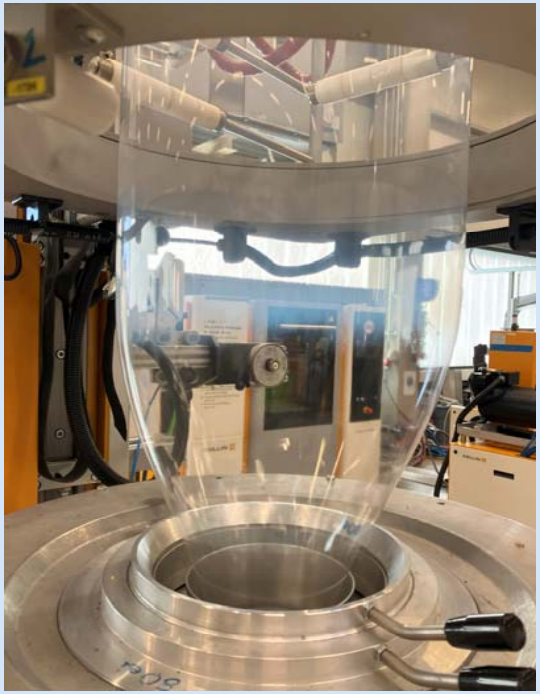
- Global leader in PVC additives:
  * Leader in Ca-based solutions
- Global metal soaps specialist and trusted partner for BAEROPOL™ additive blend solutions
- Additive solutions for polyolefins, styrenics, and engineering polymers
- 200 years of experience

Manufacturing Companies: Countries



Germany	Italy I	San Morino	Brazil	USA I & II	Korea	India
UK	Italy II	Turkey	Peru	Argentina	China	Malaysia

Reasons for change in films



Forever Chemicals

+ $11.0B settlements

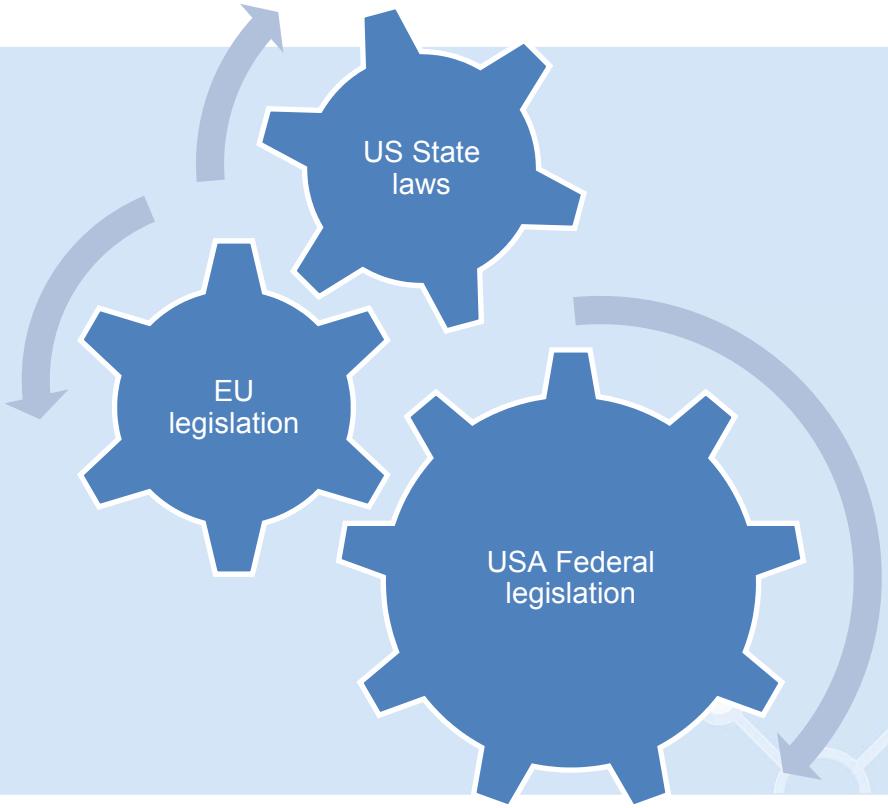
3M

U.S. PLASTIC PACT™

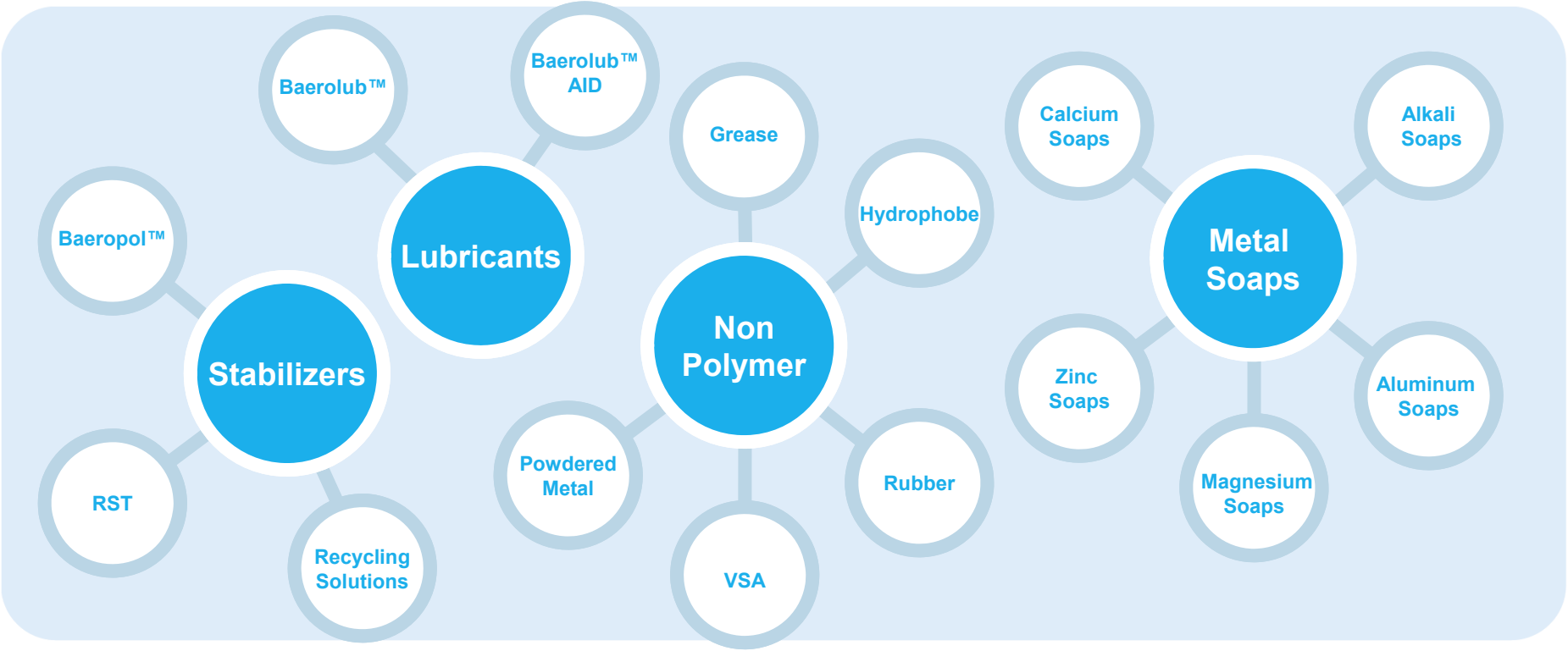
Regulatory Concerns Increased

Changing regulatory environment

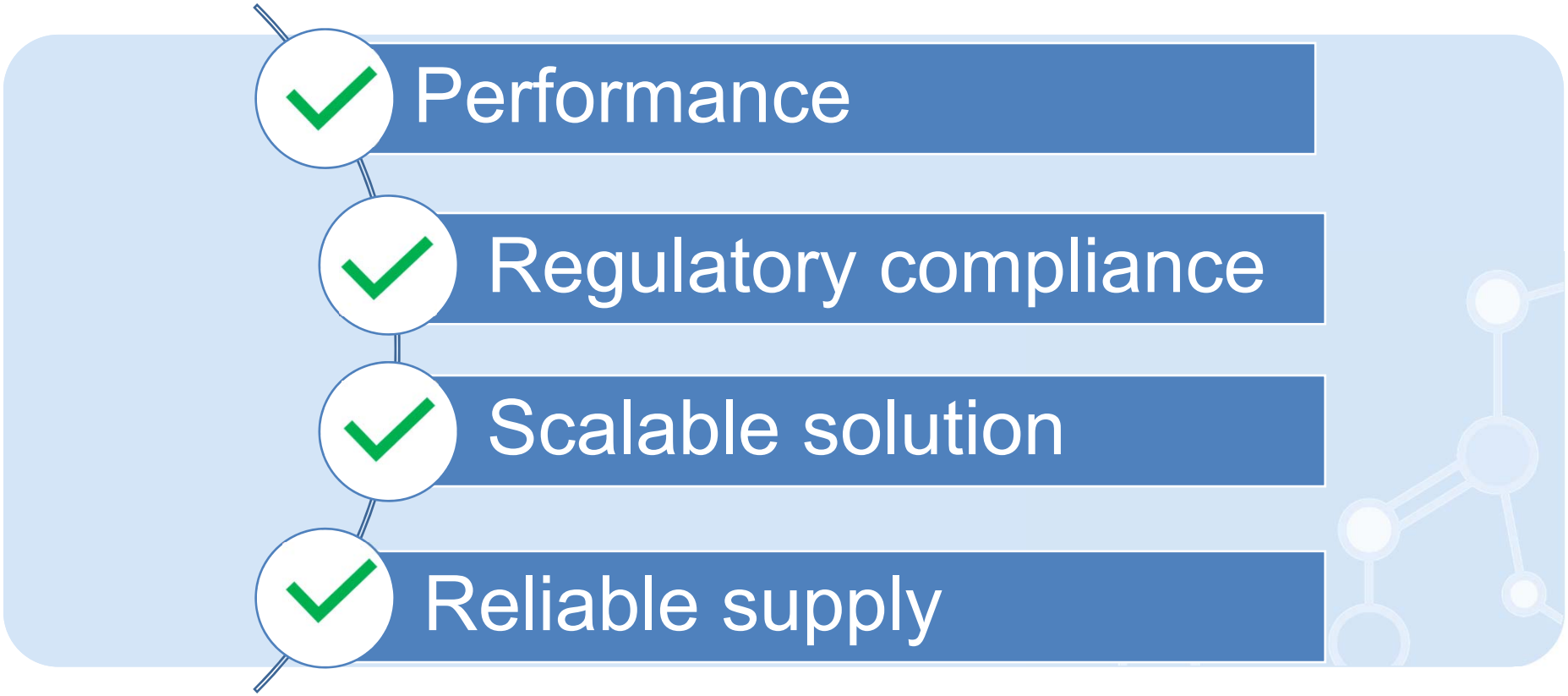
California
Colorado
Connecticut
Hawaii
Maine
Maryland
Minnesota
New York
Oregon
Rhode Island
Vermont
Washington



Special Additives Products



What the market wants



Non-PFAS options

- PPA free of PFAS and siloxane to prevent melt fracture, reduce die buildup, and reduce torque
- Products designed for maximum global food contact approvals
- Products designed for multiple product forms (powder, granule, prills, pastilles, rods)
- Can be dosed as a pre-blend, masterbatch, or neat additive
- Does not interfere with slip and anti-block
- Partially made from sustainable resources
- Available globally
- Baerolub™ AID grades legend:
  2201 --- “BA1”
  2202 --- “BA2”

** For use in LLDPE (metallocene and Ziegler-Natta types) and HMW-HDPE resins used in blown film, pipe, and wire & cable extrusion processes*

Blown film trials

- Trials were conducted at an extrusion OEM laboratory in Maitenbeth, Germany
- Using a 45 mm ‘Labline E45E’ single screw extruder attached to a ‘Labline BL 600P Blown Film Line’ with a 80 mm monolayer die

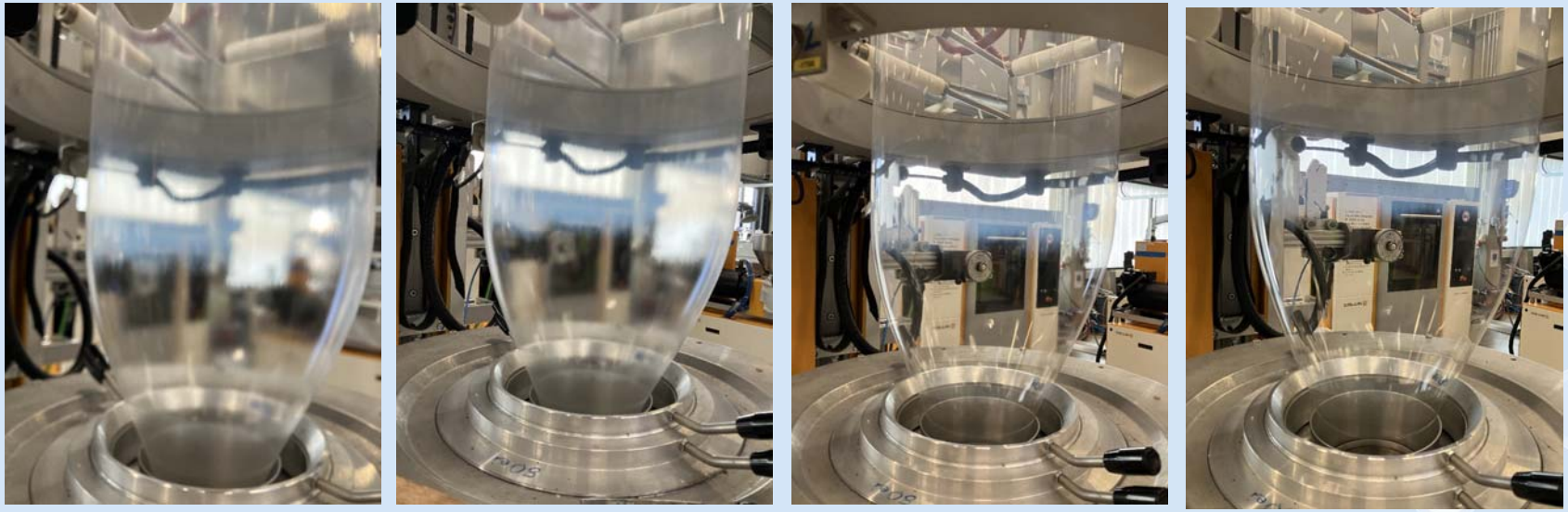
- **Conditions:**
- 1 mm die gap
- 200 °C temperature profile
- 40 rpm
- Run rate of approximately 12.5 kg/hr
- Blow up ratio 3.18 to 1
- 50 µm thickness
- Total of 4 minutes extruder dwell time
- Samples taken every 10 minutes

Blown film trials

- **Test Resin:**
- Ineos mLLDPE Eltex™ PF6212AA
- 1.3 MFI
- 0.919 density
- No slip, antiblock, UV, or PPA

- **PPA Masterbatches:**
- 5% BA1 in LDPE with 4% LDR
- 5% BA2 in LDPE with 4% LDR
- 2.5% PPA standard in LDPE with 4% LDR

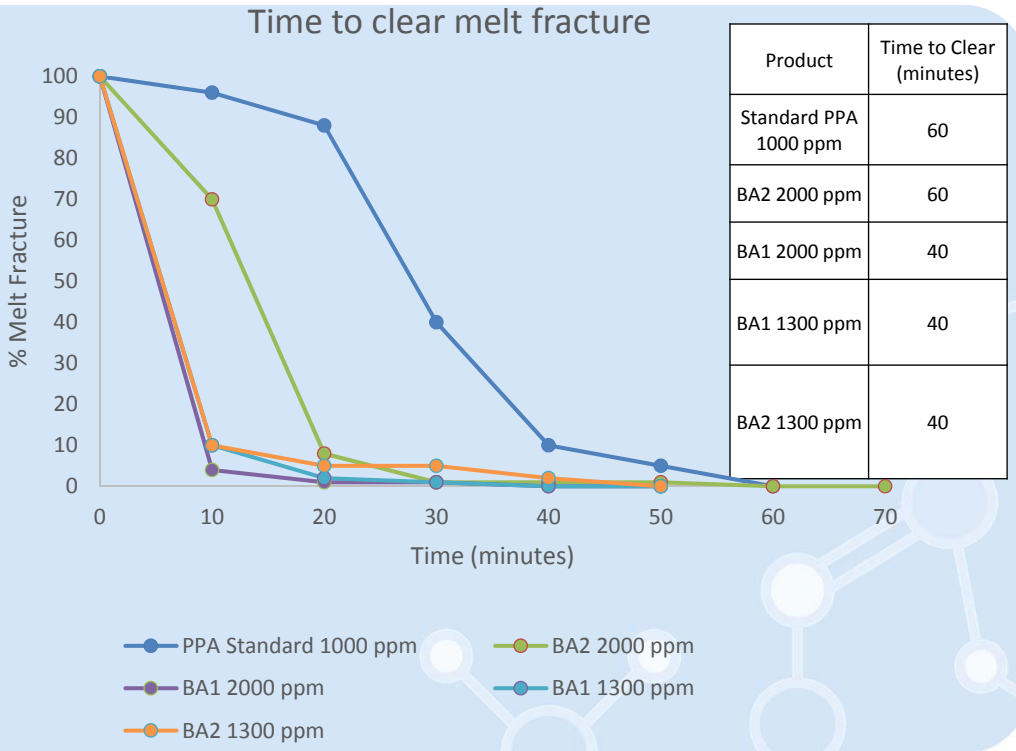
Progression of melt fracture elimination



Time 0 → Time End

Time to Clear Melt Fracture

- Additives reduced melt fracture faster than standard PPA.
- Total elimination of melt fracture was faster than standard PPA.



Product	Time to Clear (minutes)
Standard PPA 1000 ppm	60
BA2 2000 ppm	60
BA1 2000 ppm	40
BA1 1300 ppm	40
BA2 1300 ppm	40

Traditional PPA

0 minutes | 10 minutes | 40 minutes | 60 minutes

“BA1”

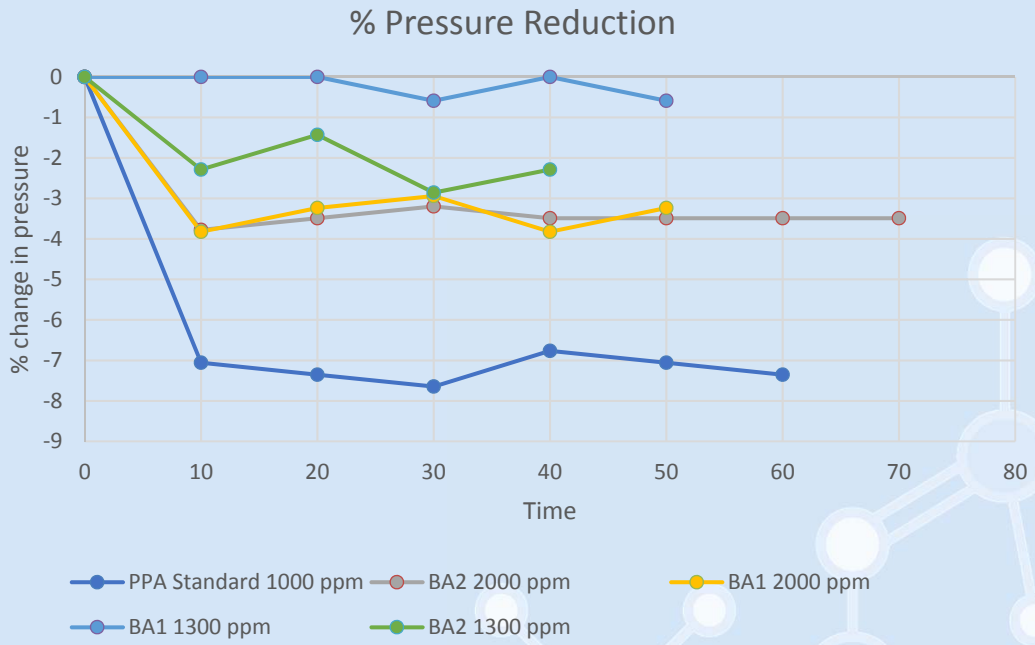
0 minutes 10 minutes 30 minutes 40 minutes

“BA2”

0 minutes 10 minutes 30 minutes 50 minutes

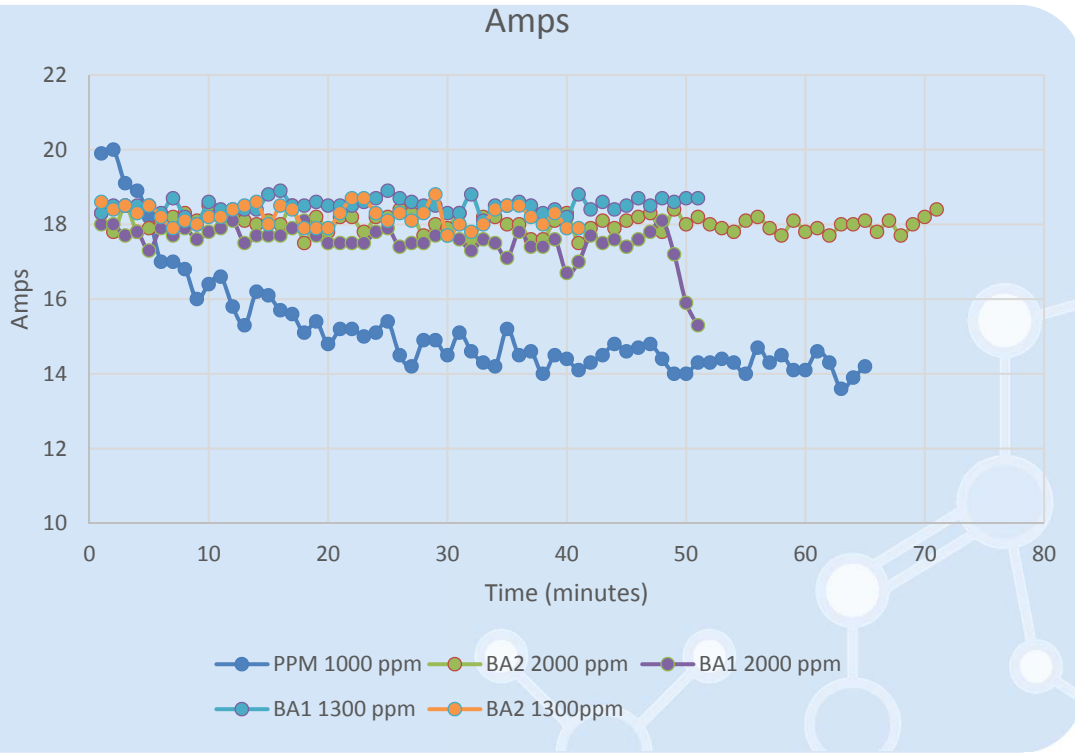
% Pressure Reduction

- At 2,000 ppm loading, extruder pressure reduced by approximately half as much as typical PPAs at 1,000 ppm.



Amps

- Standard PPA decreased amps more than BA1 or BA2.
- BA1 & BA2 did reduce amps by approximately 10% on average.



Haze and Gloss

- In general haze and gloss were seen to be slightly improved or unchanged with respect to the fluoropolymer standard

	Haze	Gloss
BA1 @ 2,000 ppm	8.08	51.9
BA2 @ 2,000 ppm	8.55	51.6
PPA @ 1,000 ppm	8.73	52
BA1 @ 1,300ppm	8.67	53.9
BA2 @ 1,300 ppm	6.97	52.9

Blown film trial observations

- Melt fracture elimination was generally seen to occur at the same rate or faster using BA1 or BA2 versus using fluorpolymer PPAs based on laboratory trials as well as customers
- Due to additive mechanism, melt fracture reduction did not occur in typical stripes of clear polymer but more of a fading of the melt fracture with time.
- No die buildup was observed during the trials.
- Excellent control of frost line height

How to use PFAS-free products

Typical suggested starting dosing rate for trials:

** **mLLDPE** -- 2,000 ppm

** **Z/N LLDPE** -- 1,500 ppm

** **HDPE** -- 1,500 ppm

** **PP** -- 1,000 ppm

Special Thanks to:

Beisterfeld AG, for assistance with resin sourcing for extrusion tests.

COLLIN Lab & Pilot Solutions GmbH, for use of a blown film lab line.

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