NatureWorks

Ingeo™ Extend 4950D: Manufacturing Efficiency on BoPP Lines and Improved Barrier Performance

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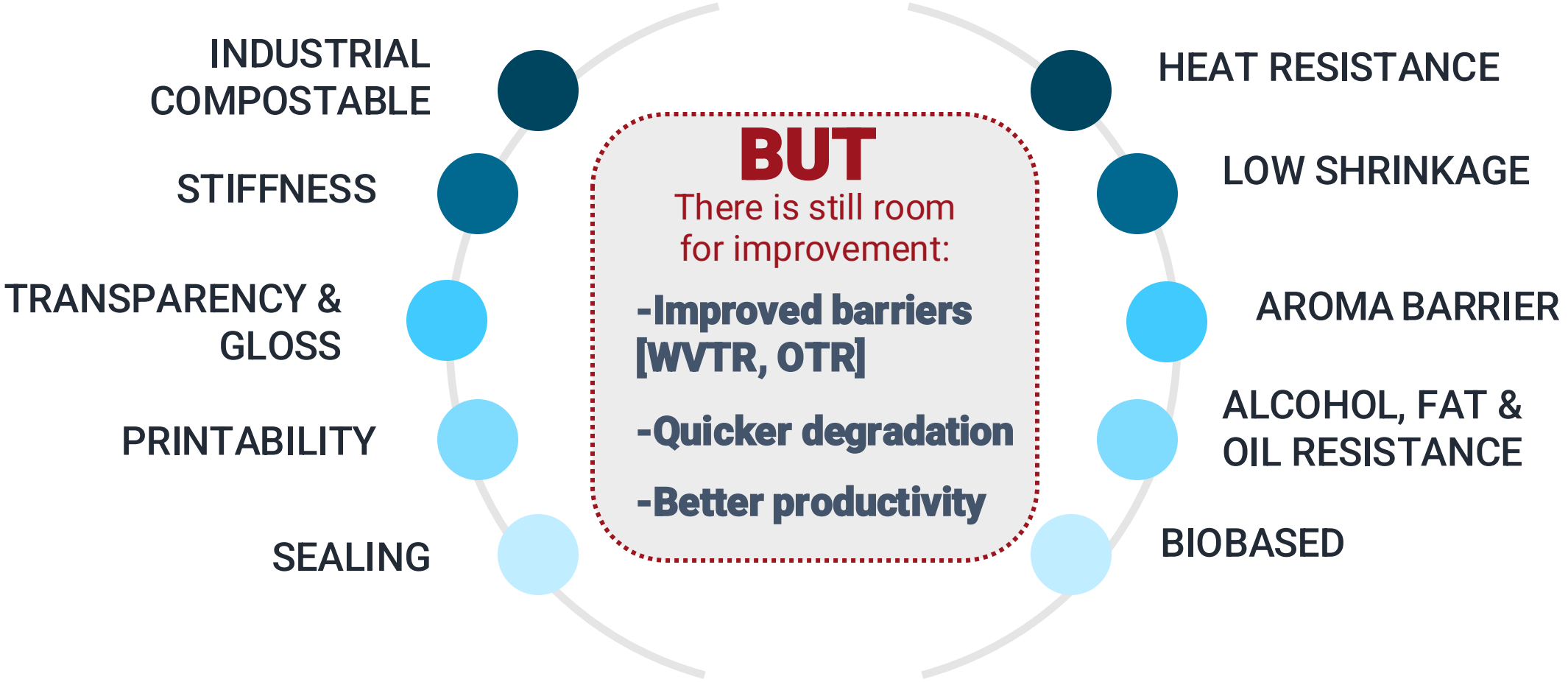
BoPLA Film in Use TODAY



Familiar Processing, Better Results

The Ingeo™ Extend 4950D solution

- Designed for efficient processing on BOPP equipment
- Enhances stretch-ratio
- Reduces manufacturing cost of BoPLA film
- Faster biodegradation
- Improved barrier properties

Set for Success

Ingeo™ Extend 4950D solution is available now

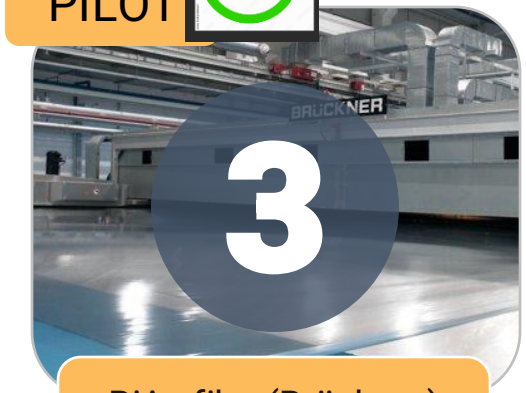
LAB

Karo Lab capabilities

Proof of Concept

A4 samples surface evaluations

PILOT



BiAx film (Brückner) Pilot trial

PROTOTYPE

Metallization & lamination industrial scale

SCALE UP

Alox/Met/Barrier coatingsx

INDUSTRIALIZATON

Lamination at industrial partners

2025Q2

INDUSTRIALIZATON

Filling at machine suppliers or Brands

BRÜCKNER MASCHINENBAU
A Member of Brückner Group

KA SUONO

NatureWorks

A Solution that Optimizes Coefficient of Friction and Transparency

Features

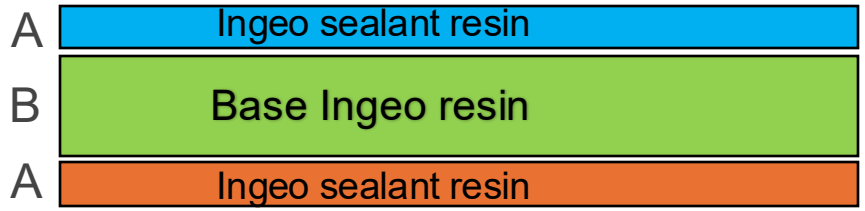
- Grades offering different surface roughness for OPLA-films
- Highly dispersed antiblock
- Optimized PLA carrier
- Specific composition for each side of the film

Benefits

- Low CoF with better optical properties
- Easy processing and good printability
- Compatibility with Ingeo resin layers

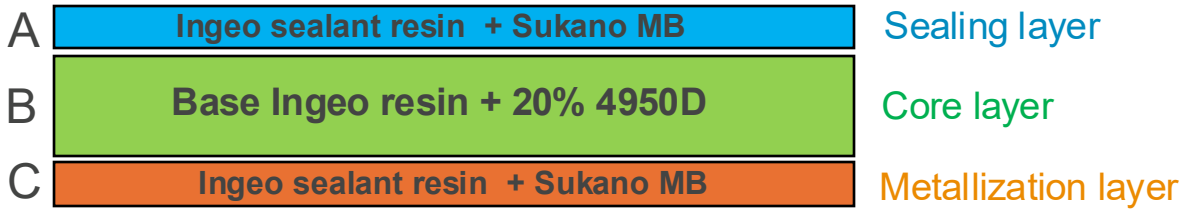
Optimized Ingeo Film Structure

TODAY [20 µm]



- Can run in BOPET lines with modifications
- Industrially compostable

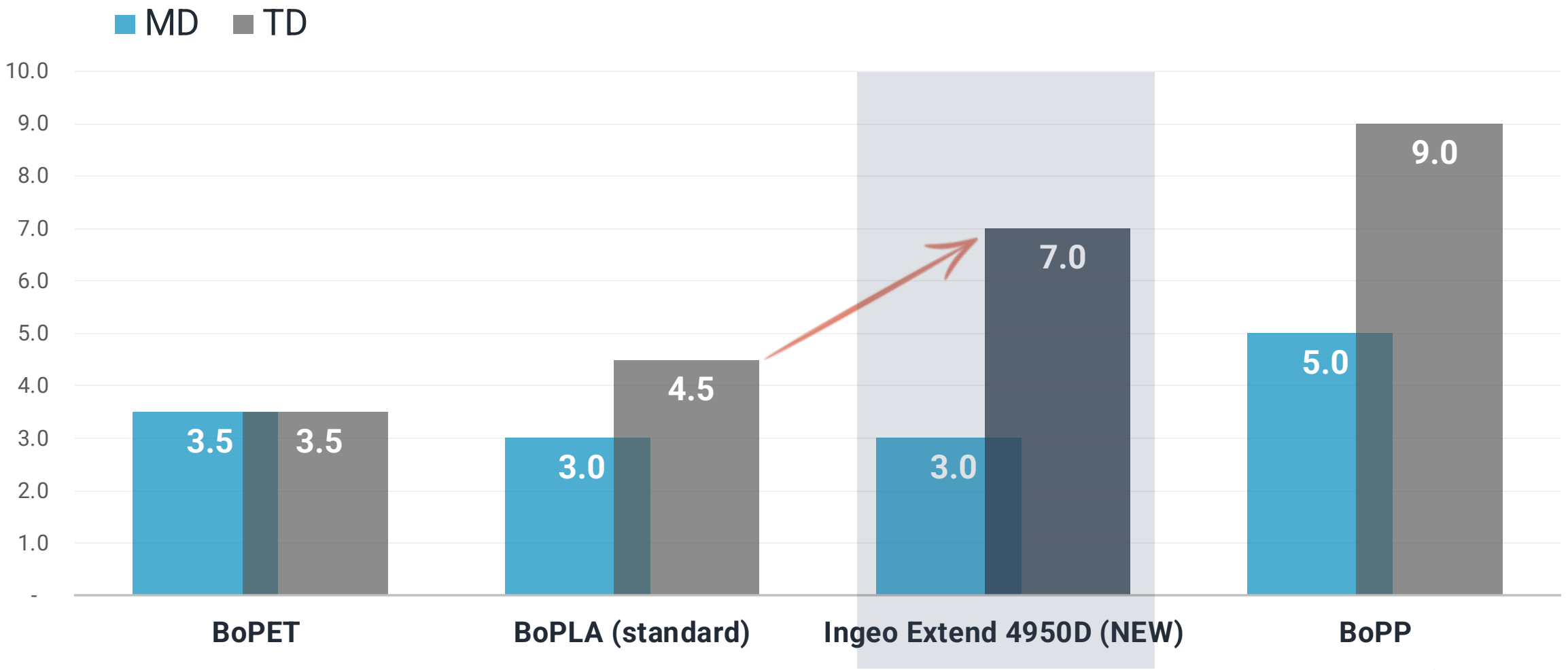
Ingeo™ Extend 4950D [20 µm]



- Runs in BOPP lines
- Industrially compostable
- High WTR and OTR barrier
- Tested LISIM and Sequential process
- A skin layer
  - Designed for sealing with AB-MB03
- C skin layer
  - Designed for metallization with AB-MB06
  - Corona treatment

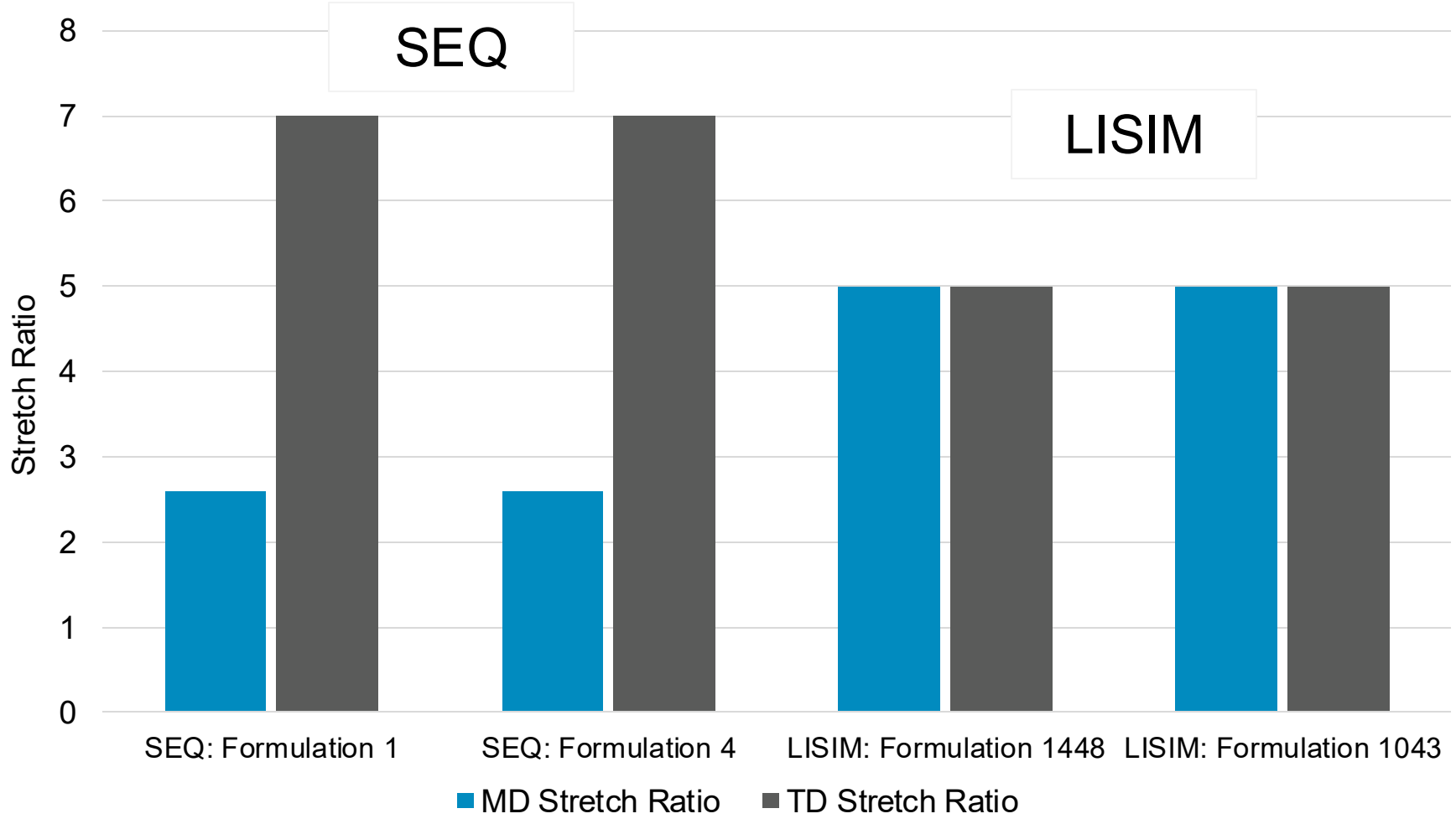
7x Stretch Ratio

BiAx stretch ratios comparison (PET, PP, PLA, new Ingeo™ Extend 4950D)



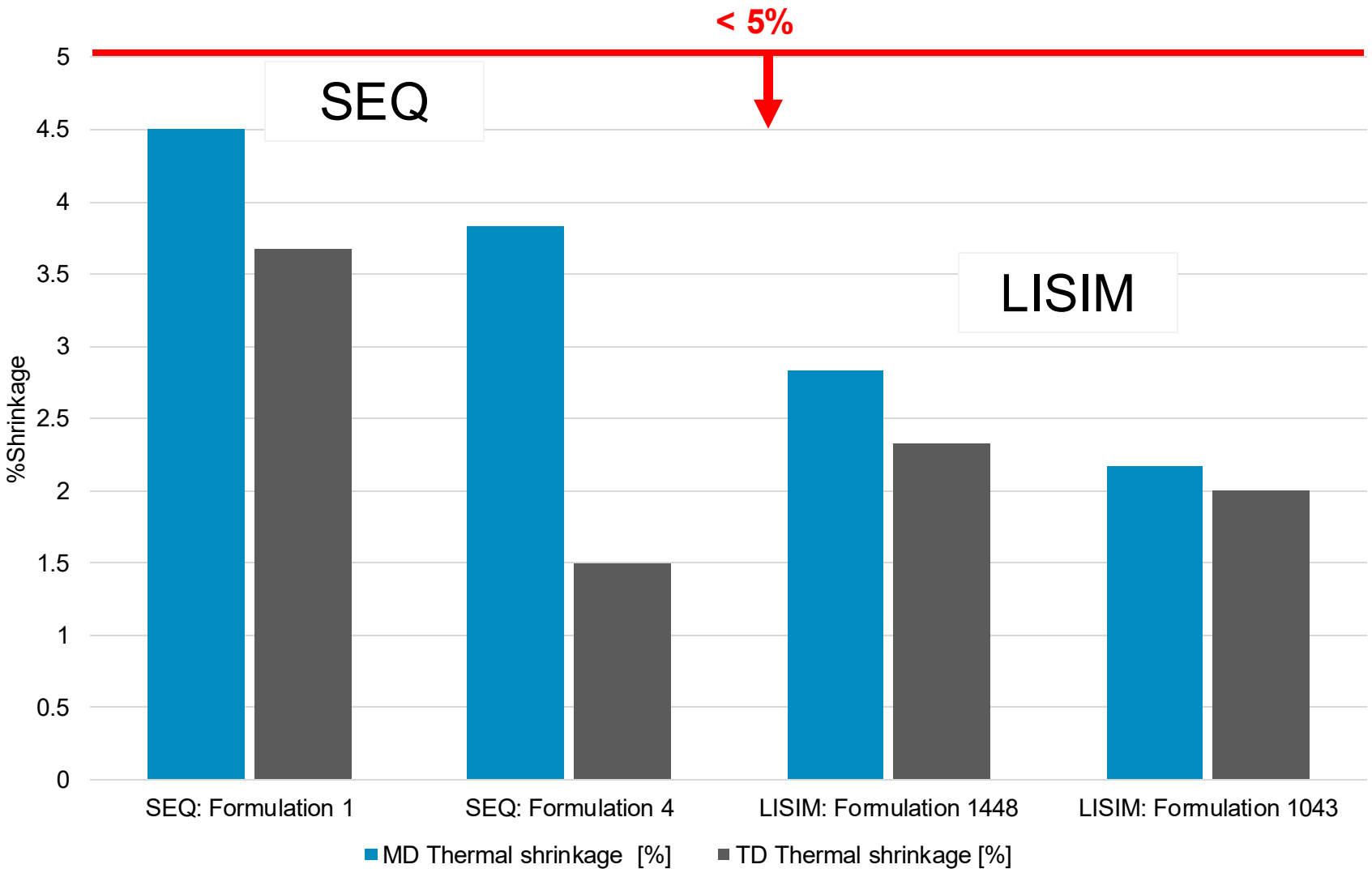
High Stretch Ratio Means High Throughput

✓ Compatibility on existing BiAx lines with minimum modification



High Thermal Stability

Thermal shrinkage testing at 130°C for 5 minutes

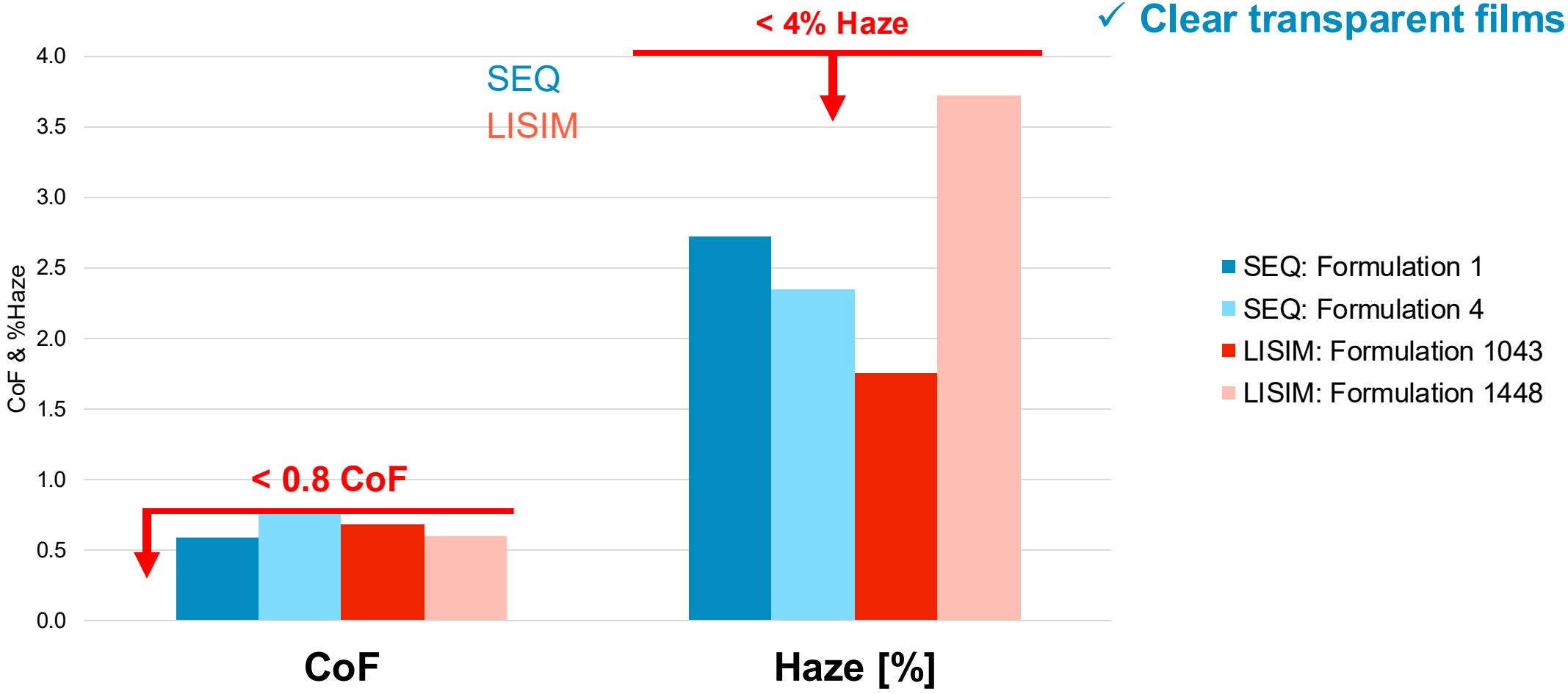


Annealing of the films

- To relax the amorphous phase orientation
- To increase crystallinity

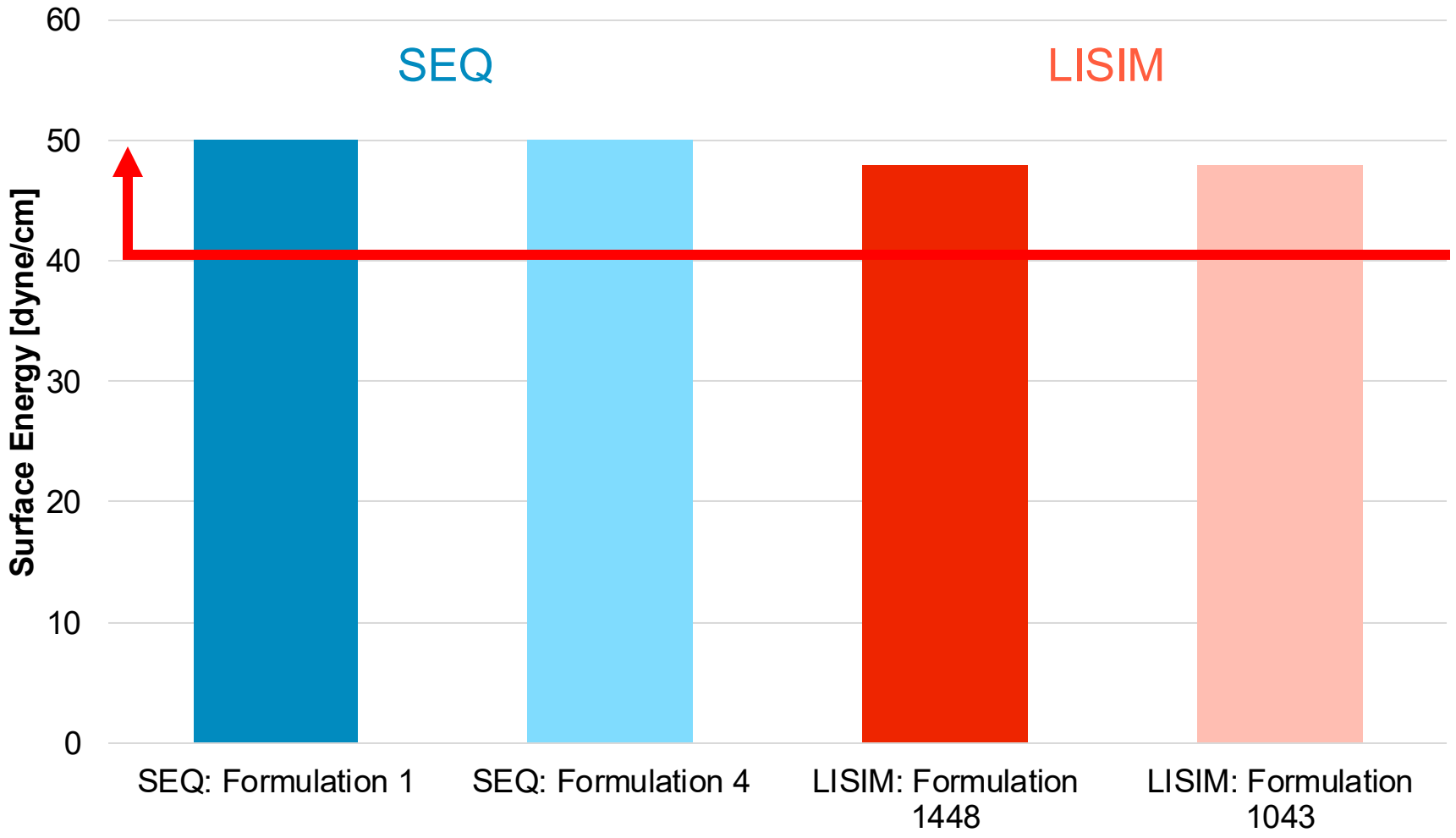
Low Coefficient of Friction < 0.8 [ASTM D1894]
Low Haze < 4% [ASTM D1003]

- ✓ **Less stickiness during winding and unwinding of the rolls**
- ✓ **Clear transparent films**



Surface Energy >40 dyne/cm [ASTM D2578]

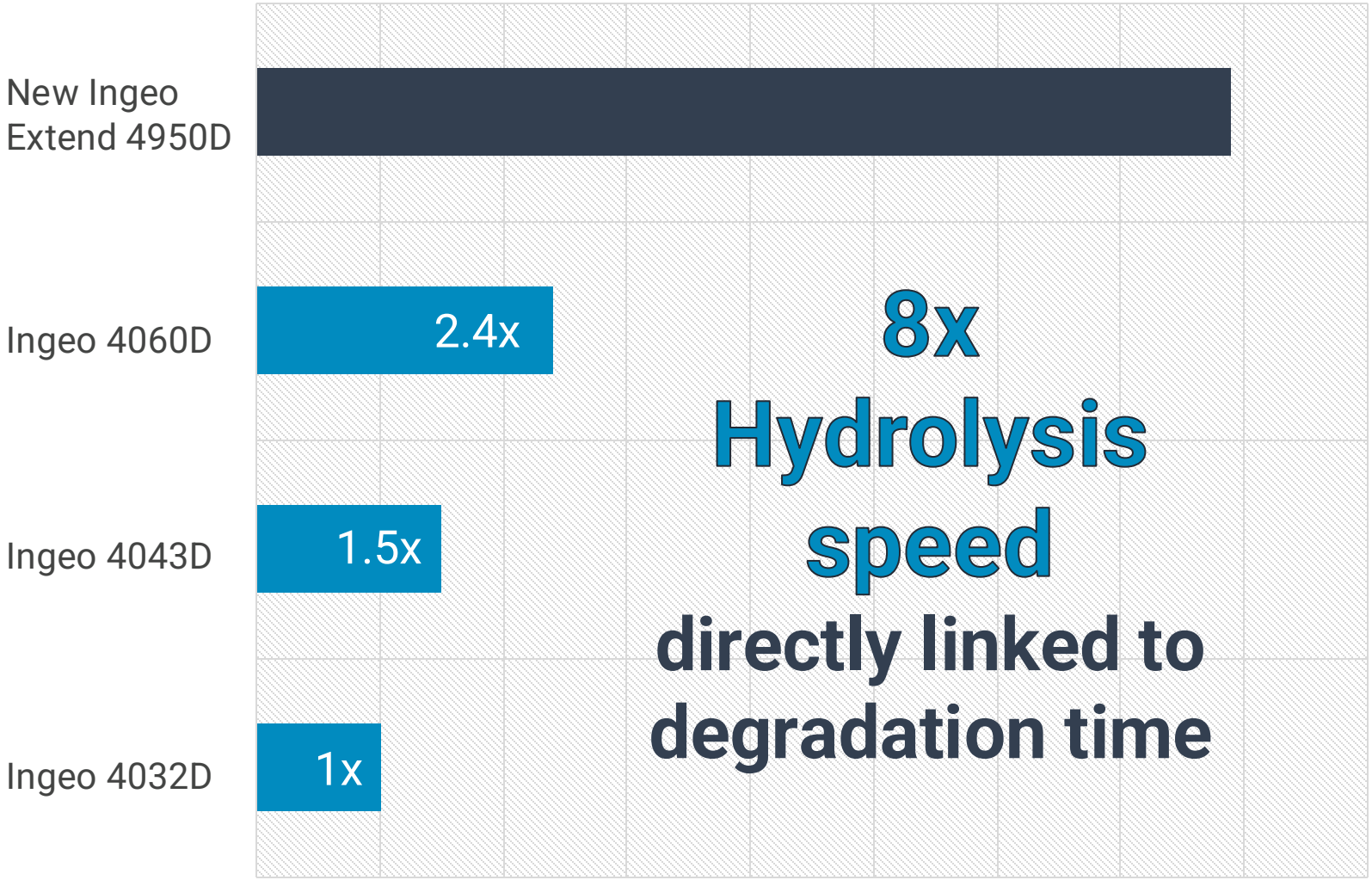
With Corona Treatment



>40 dyne/cm:

- **Better printability**
- **Better lamination/ metallization**

Faster Biodegradation

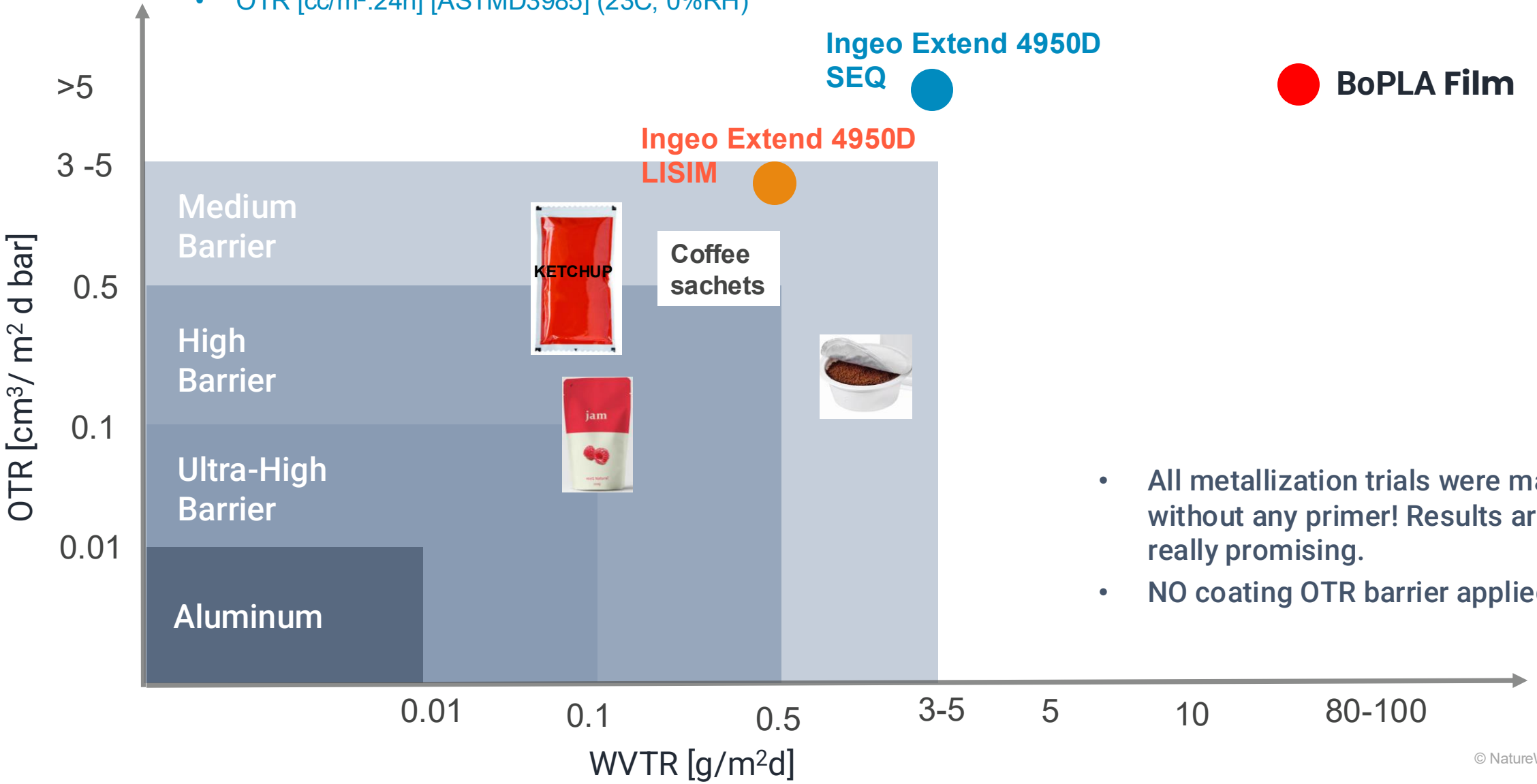


Ingeo Extend 4950D hydrolyzes 8x faster than 4032D at 50°C

Blending Ingeo Extend 4950D with slower hydrolyzing PLA or polyesters can accelerate hydrolysis in the final material.

Improved Barrier Performance

- WVTR [g/m².24h] [ASTM F1249]
- OTR [cc/m².24h] [ASTMD3985] (23C, 0%RH)



- All metallization trials were made without any primer! Results are really promising.
- NO coating OTR barrier applied

NatureWorks Ingeo™ Extend 4950D: Engineered for Performance

A Solution Available Now

- ✓ Use in existing BoPP lines
- ✓ High throughput
- ✓ Improved WVTR & OTR barrier properties
- ✓ Clear transparent films
- ✓ Faster biodegradation
- ✓ Easily processed during secondary processing steps
  - Low Coefficient of Friction <0.8
  - High Surface energy >40 dynes/cm
  - High thermal stability (%thermal shrinkage <5%)

Thank You

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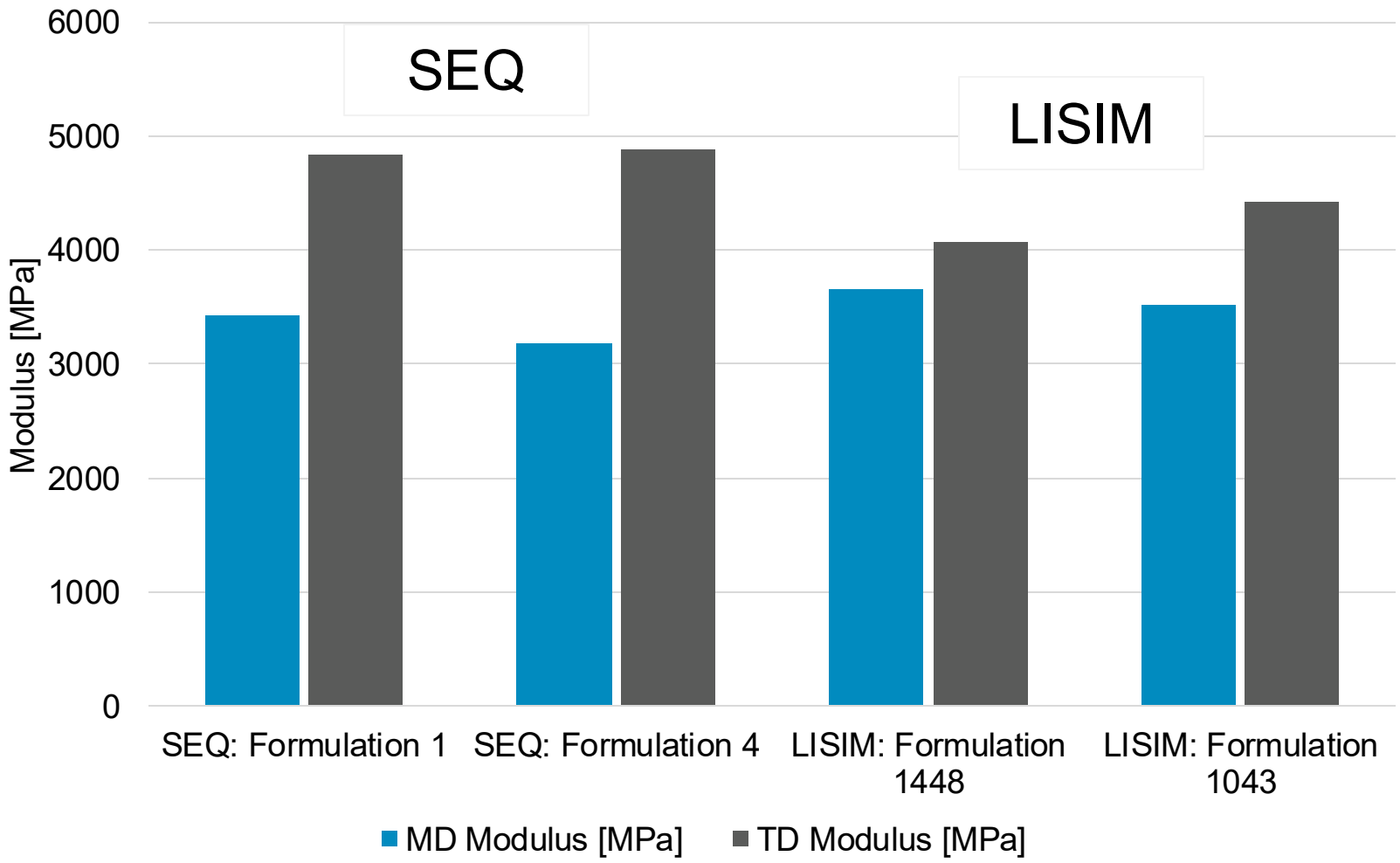
Appendix

Tensile Modulus- ASTM D882



Ho.Re.Ca. - Flexible Portion Packs

PPWR ban on single-use plastic packaging for condiments, preserves, sauces, coffee creamer, sugar, and seasoning in Ho.Re.Ca. sector

Derogation from the ban if compostable

BoPLA part of the multilayer structure

RESTRICTIONS ON USE OF CERTAIN PACKAGING FORMATS
(Articles of reference: Article 9(2)(b), Article 25 (3) and Annex V (4))

Ho.Re.Ca. – Lidding small portions

Opportunity for BoPLA based lids to support expected growth of compostable small rigid containers

Derogation from the ban if compostable

BoPLA part of the lidding

RESTRICTIONS ON USE OF CERTAIN PACKAGING FORMATS
(Articles of reference: Article 9(2)(b), Article 25 (3) and Annex V (4))

Coffee Capsules - Lidding

Specific regulation on single-serve beverages to allow industrial compostable capsules (and lidding)

Allowed to be industrial compostable

BoPLA key lidding element

COMPOSTABLE PACKAGING
Articles of reference: Article 3(1), point (1)(g), article 9(2)(a)
For Paper-based coffee capsules likely applies (Article 3(1), point (1)(f) and Article 9(1)