



Superior Tear Resistance from a Polyamide: Is the flexible packaging world ready for a LLDPA?

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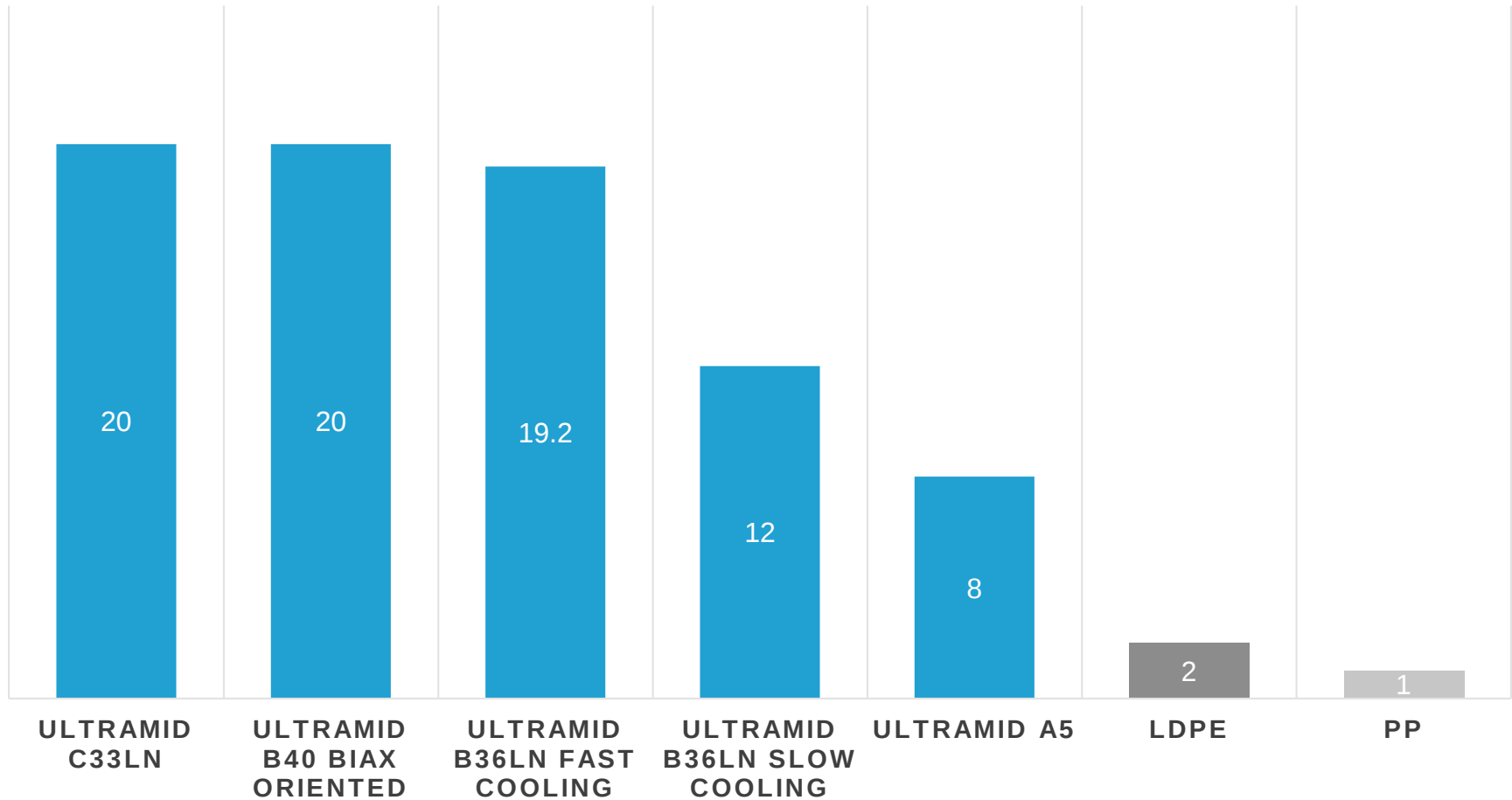
The Chemical Company

Polyamides are useful for numerous reasons



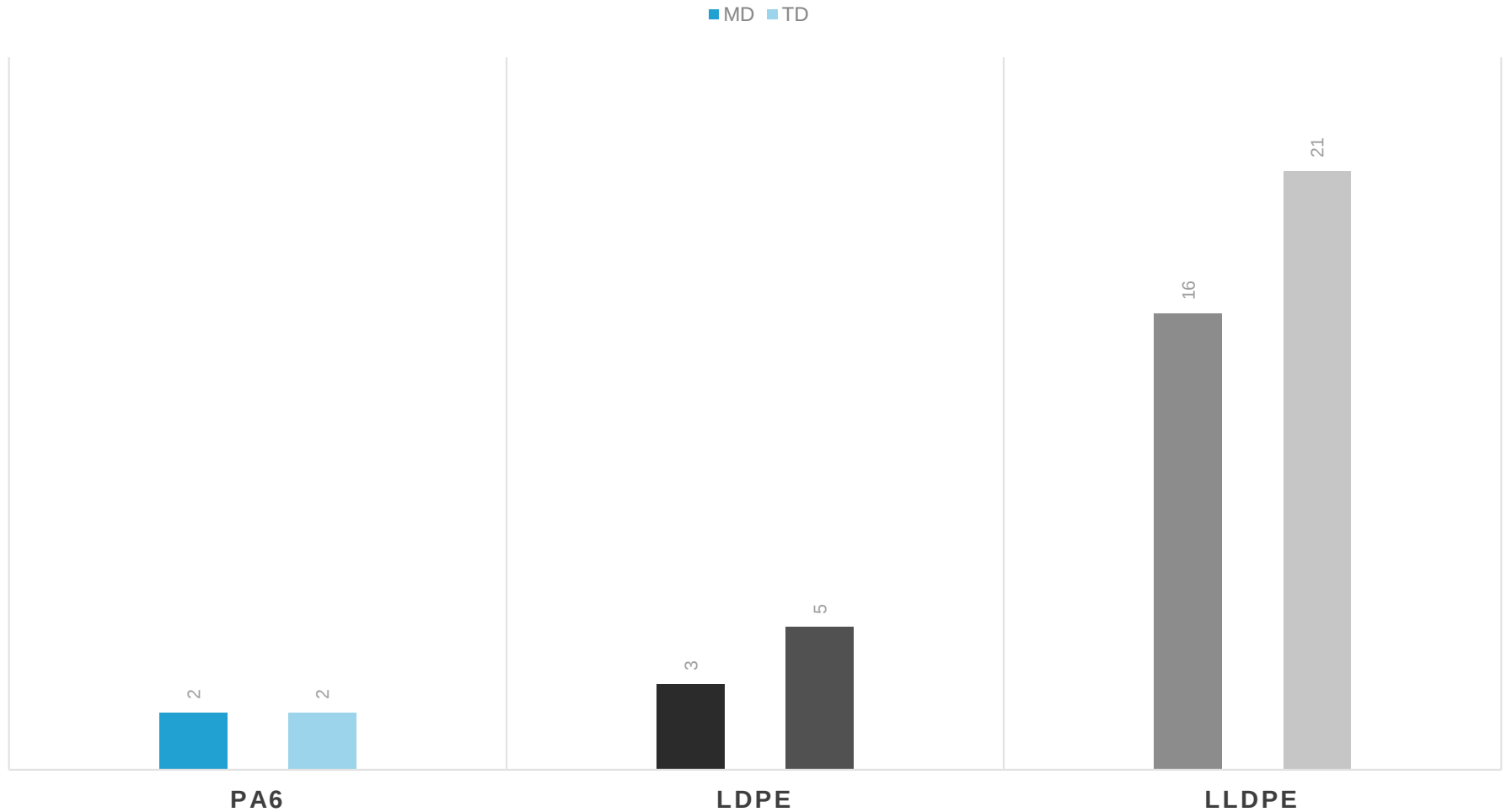
- High Mechanical Strength
 - *Fishing line, Rope, Bristles*
- Easily co-extruded
 - *Multilayer structures with dissimilar polymers possible*
- Heat & Chemical Resistance
 - *Roasting bags, Intake manifolds*
- Thermoformable
 - *High residual corner thickness*
- Barrier
 - *Barrier mulch film*
- Abrasion Resistance
 - *Weed trimmer, wire jacketing*

Toughness of Polyamides set them apart



Puncture Energy (N*mm); ISO 7765-2; $\varnothing$ 2.5mm, 50 μ m cast film; normalized PP=1

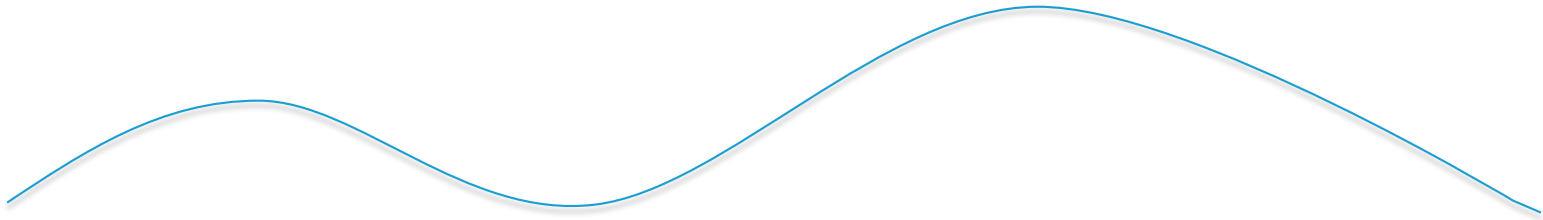
Elmendorf tear is lower, though



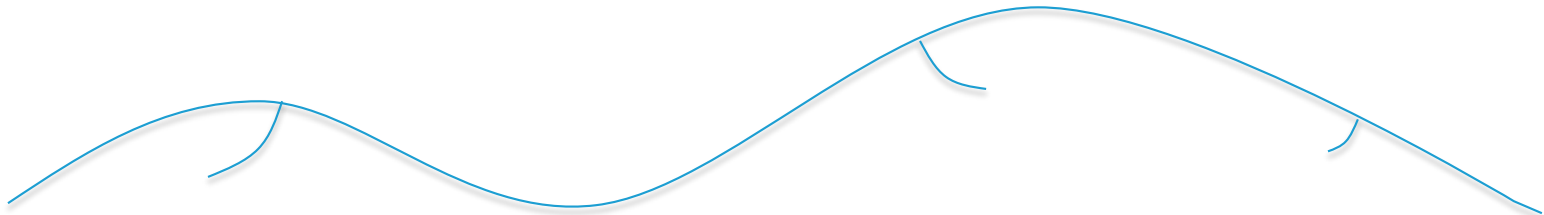
ISO 6383-2; 100µm monolayer blown film; BUR 2:1

Structure affects properties

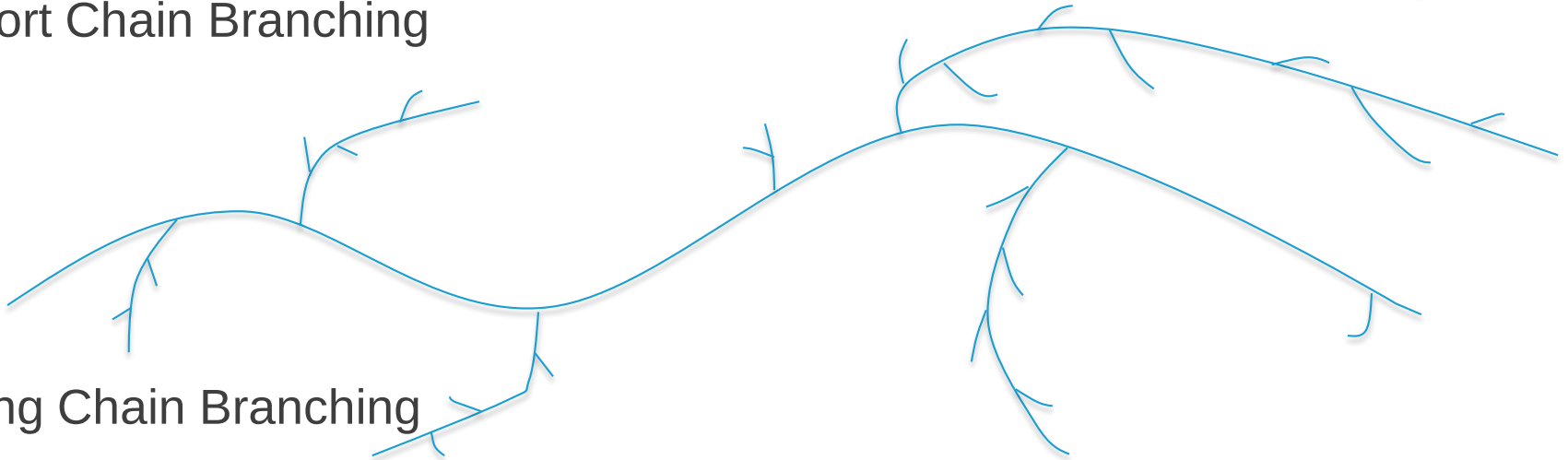
Linear



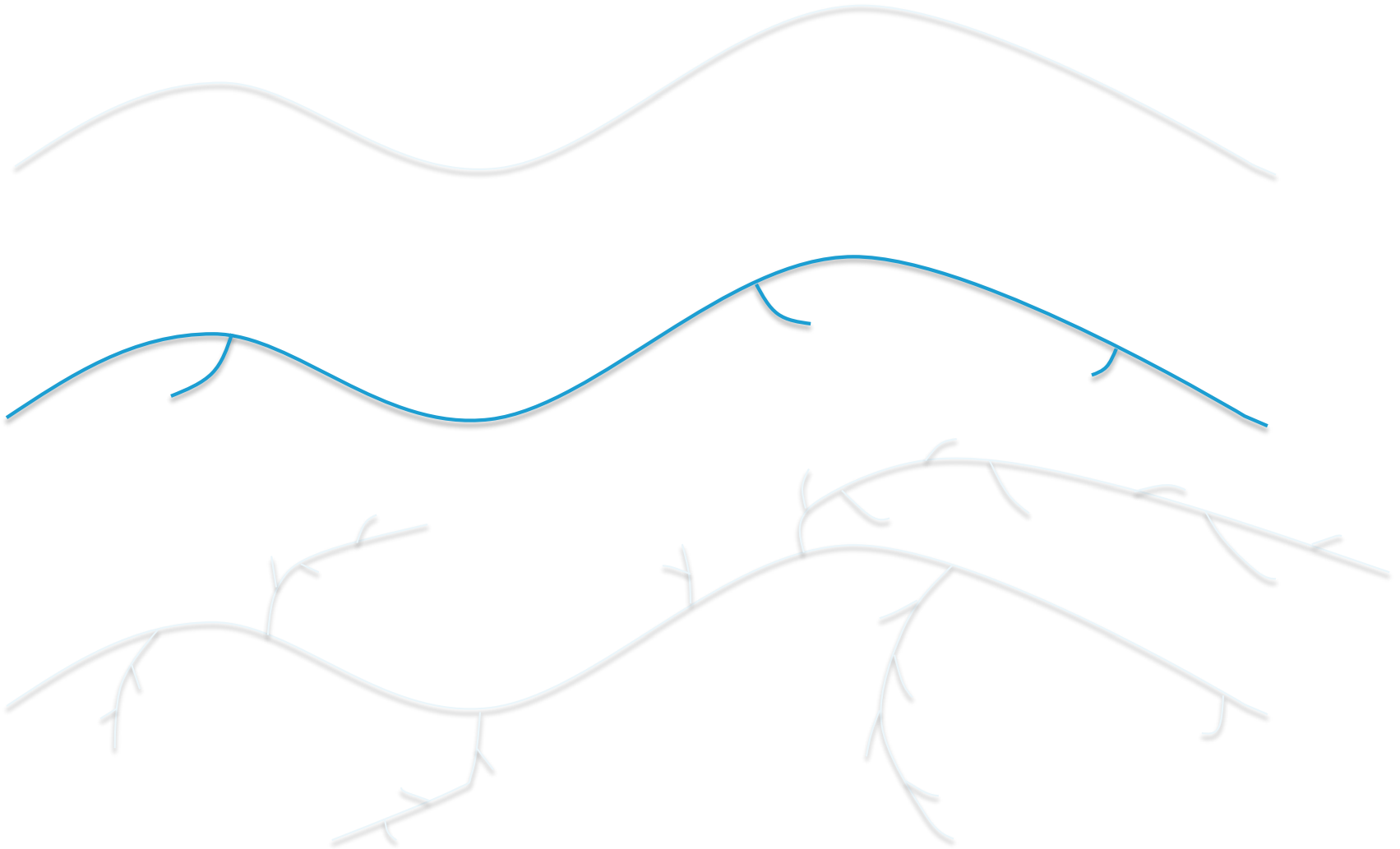
Short Chain Branching



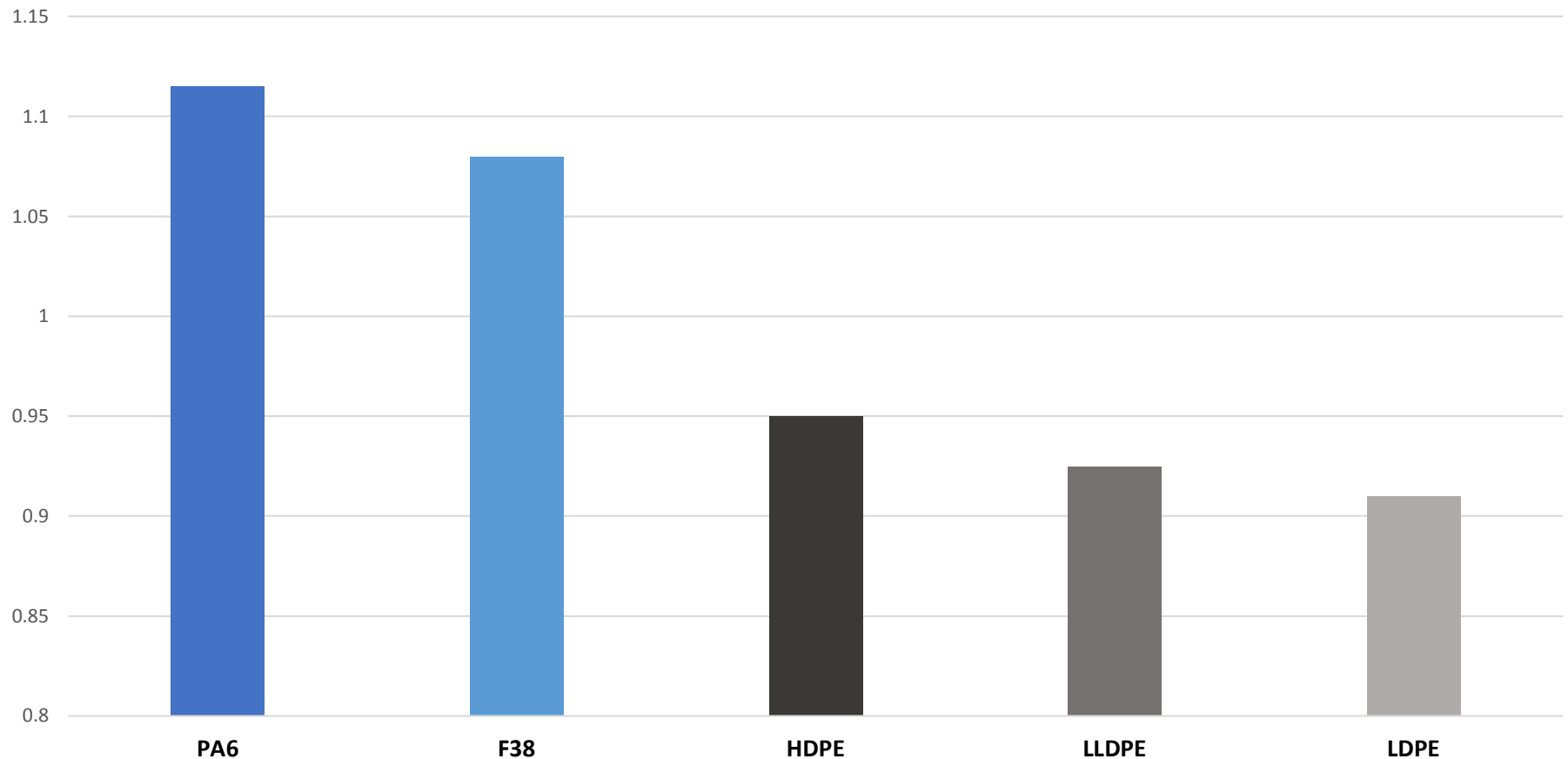
Long Chain Branching



Ultramid® Flex F38: A new class of polyamide

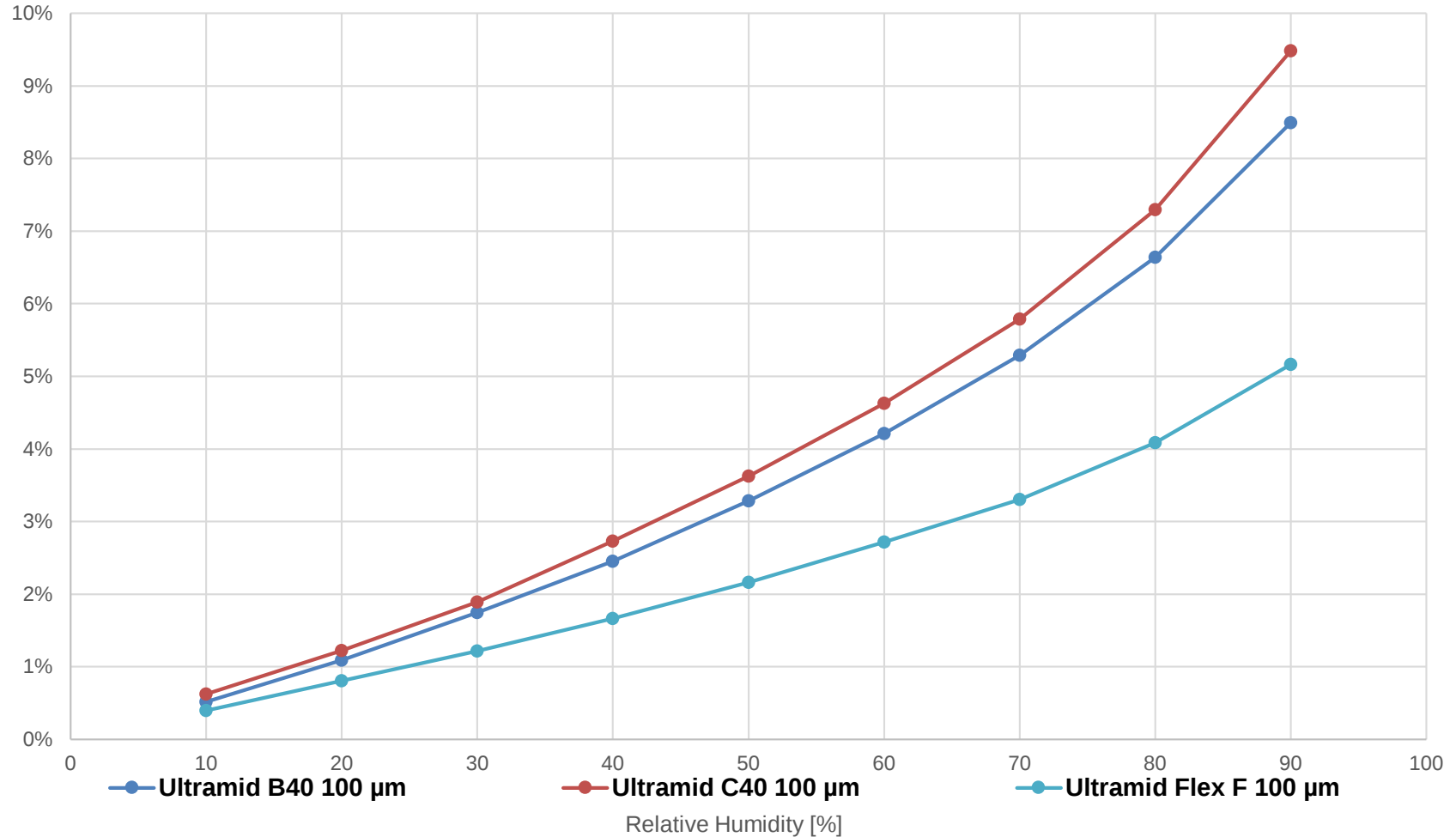


Density Comparison

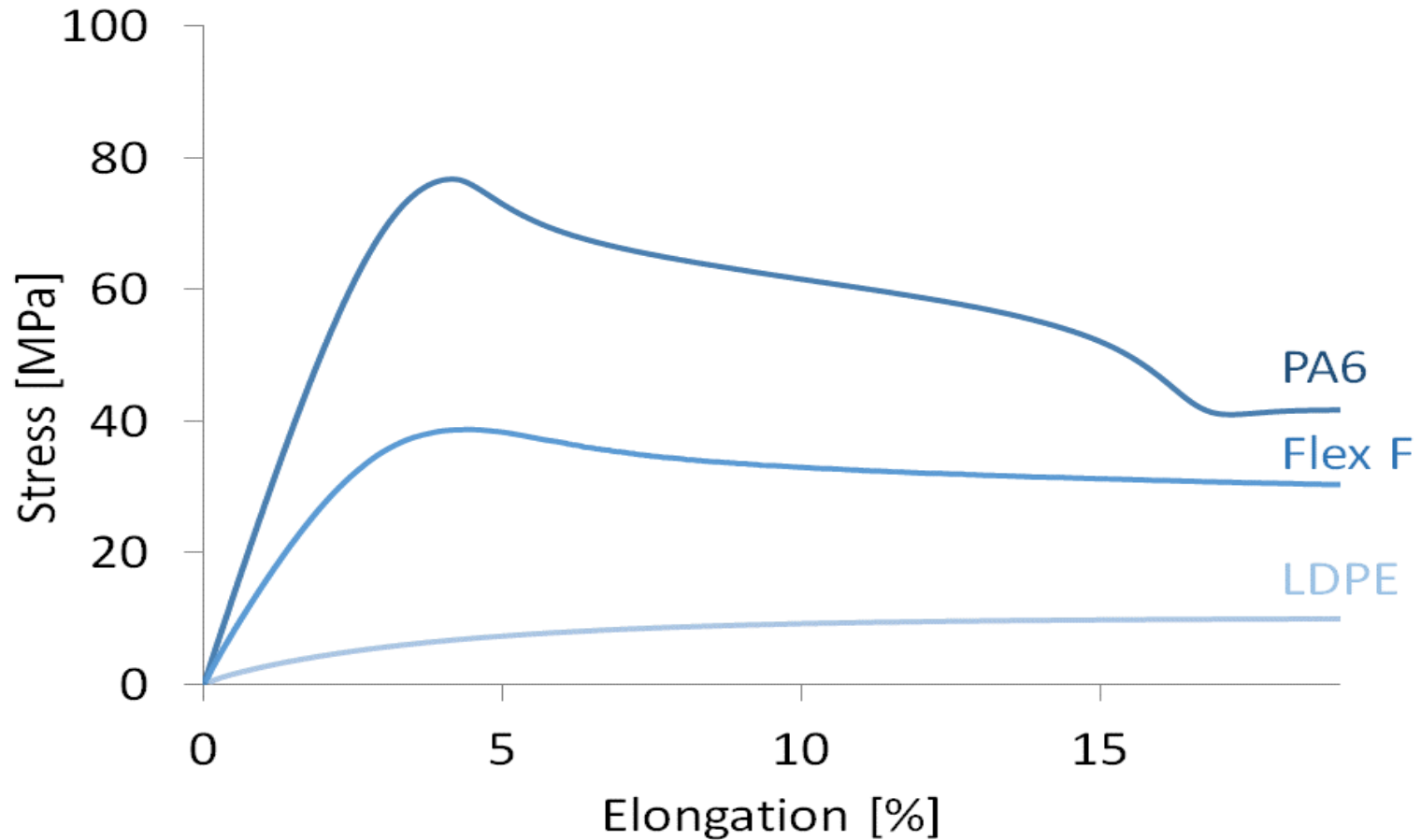


ISO 1183-3; 100 μ m monolayer blown film

Novel structure reduces water uptake

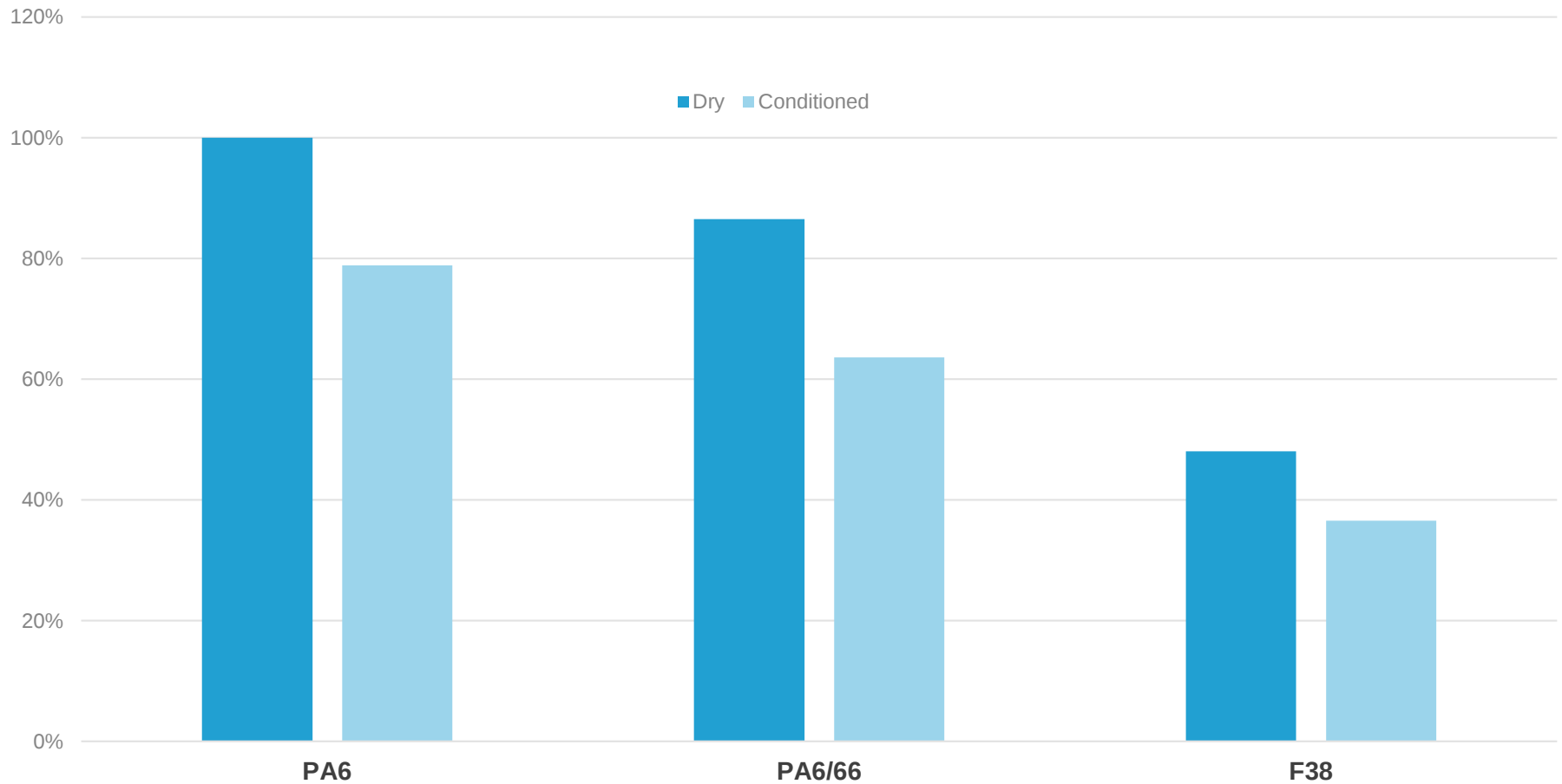


...and ensures softness even when dry



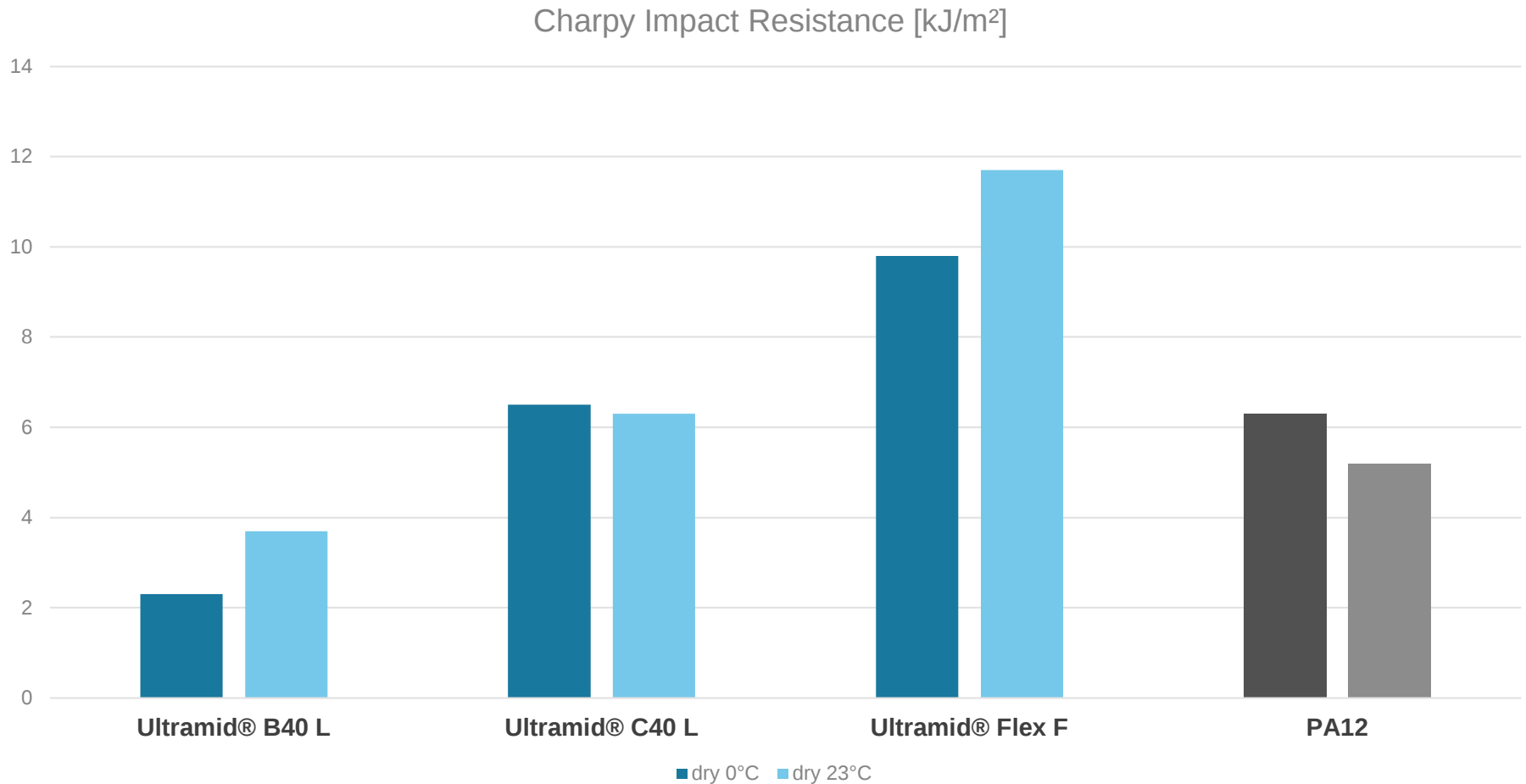
Injection molded samples; ISO 527-2; dry, 23C

Elastic Modulus Comparison



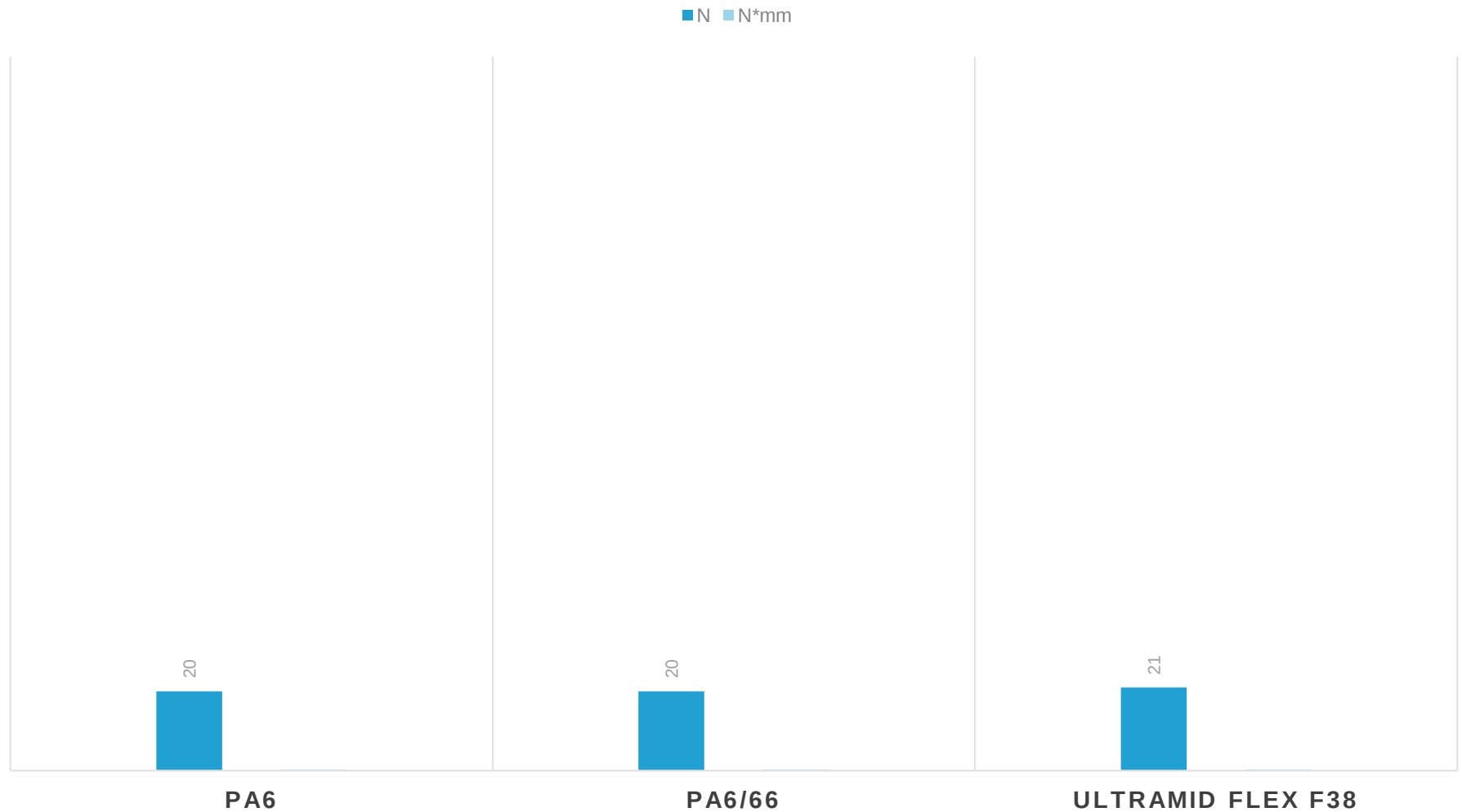
Injection molded samples; ISO 527-2; data normalized to PA6 Dry = 100%

But is Ultramid® Flex F38 like PA12?



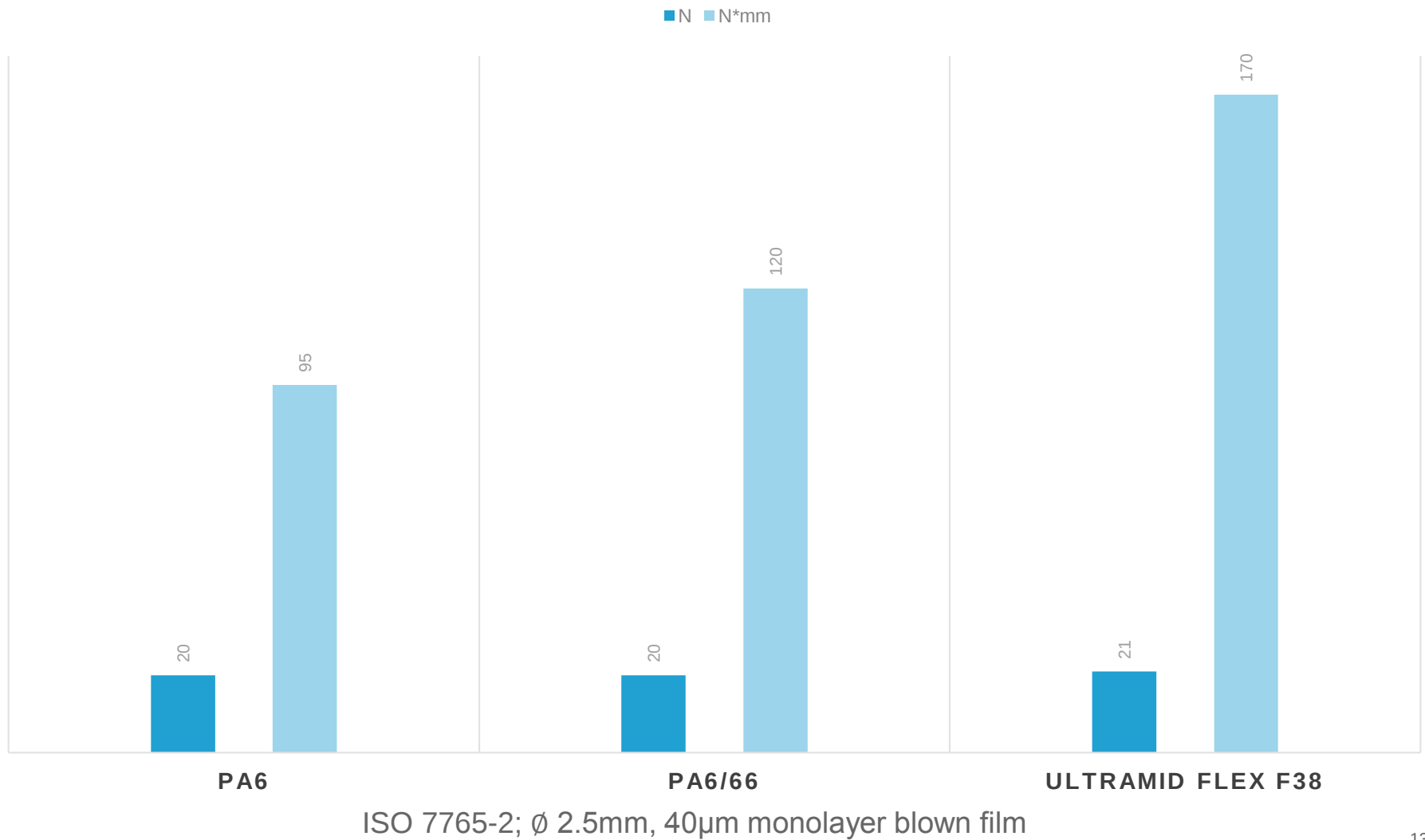
Injection molded samples; ISO 179-2/1eA(S)

Ultramid® Flex F38 retains puncture strength

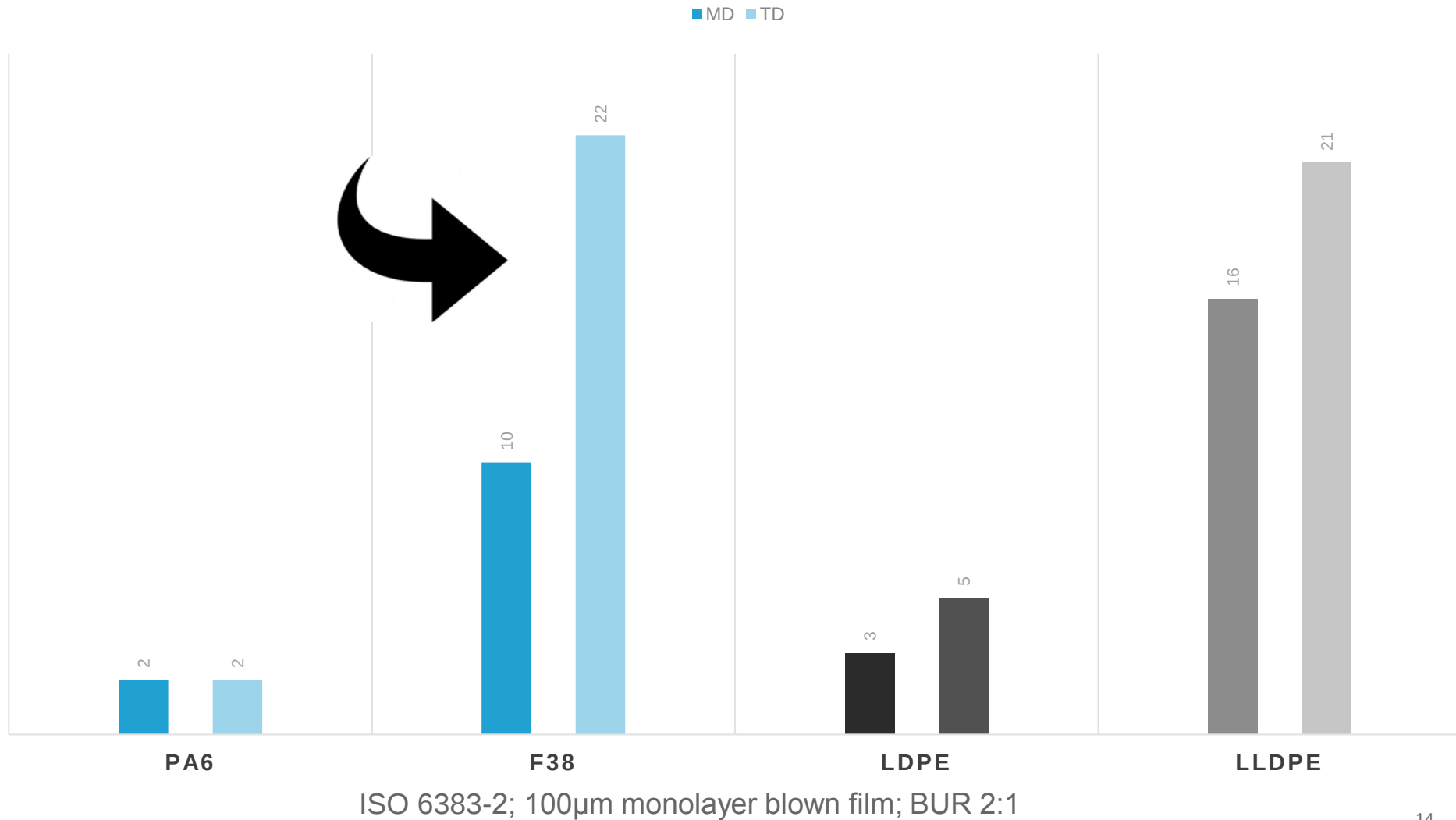


ISO 7765-2; Ø 2.5mm, 40µm monolayer blown film

...and provides even higher puncture energy



While Elmendorf tear resistance is dramatically higher in monolayer films

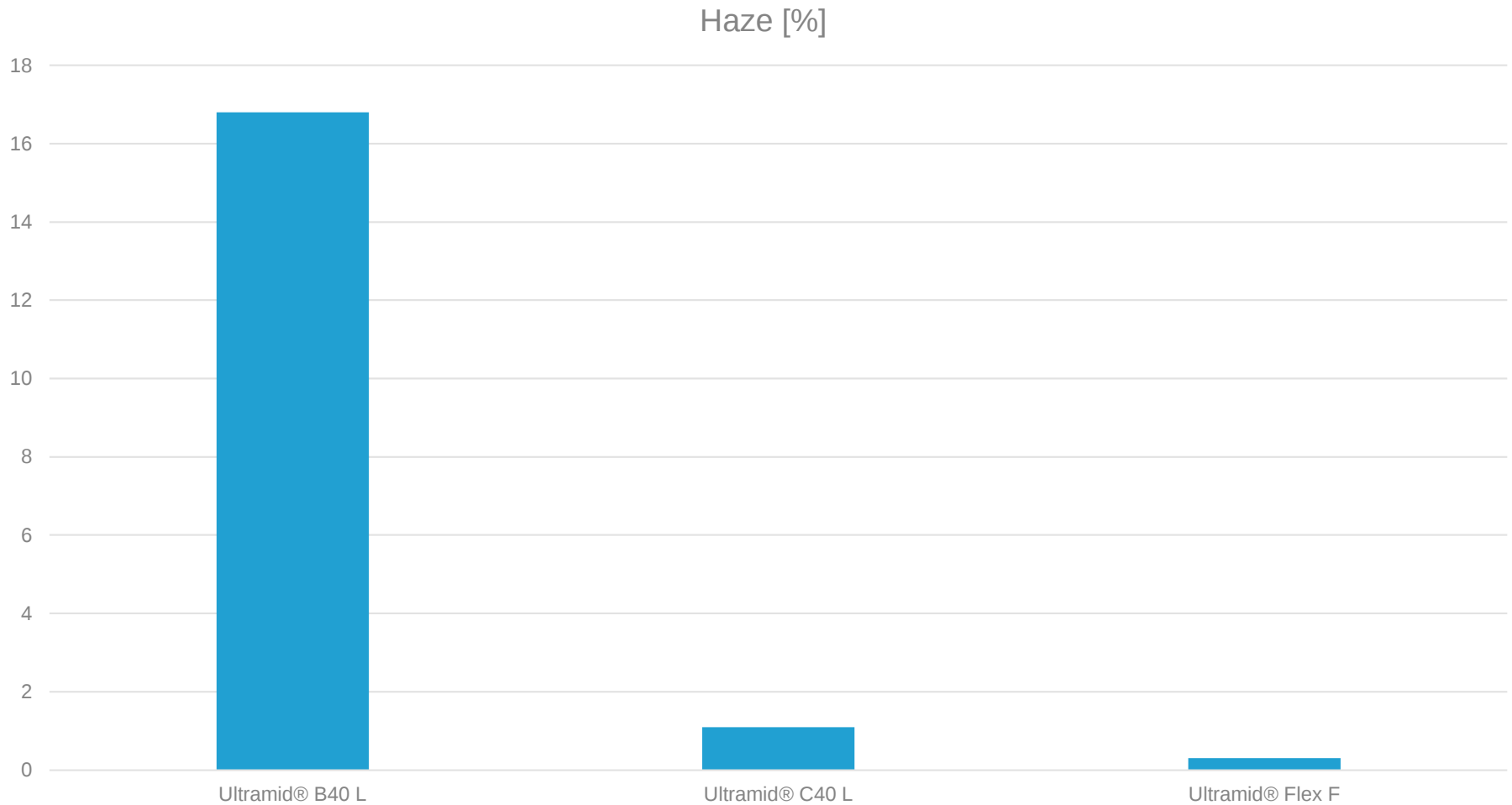


...and multilayer films



ISO 6383-2; 100µm multilayer blown film; BUR 2:1; LDPE//Tie//PA//EVOH//PA//Tie//LDPE

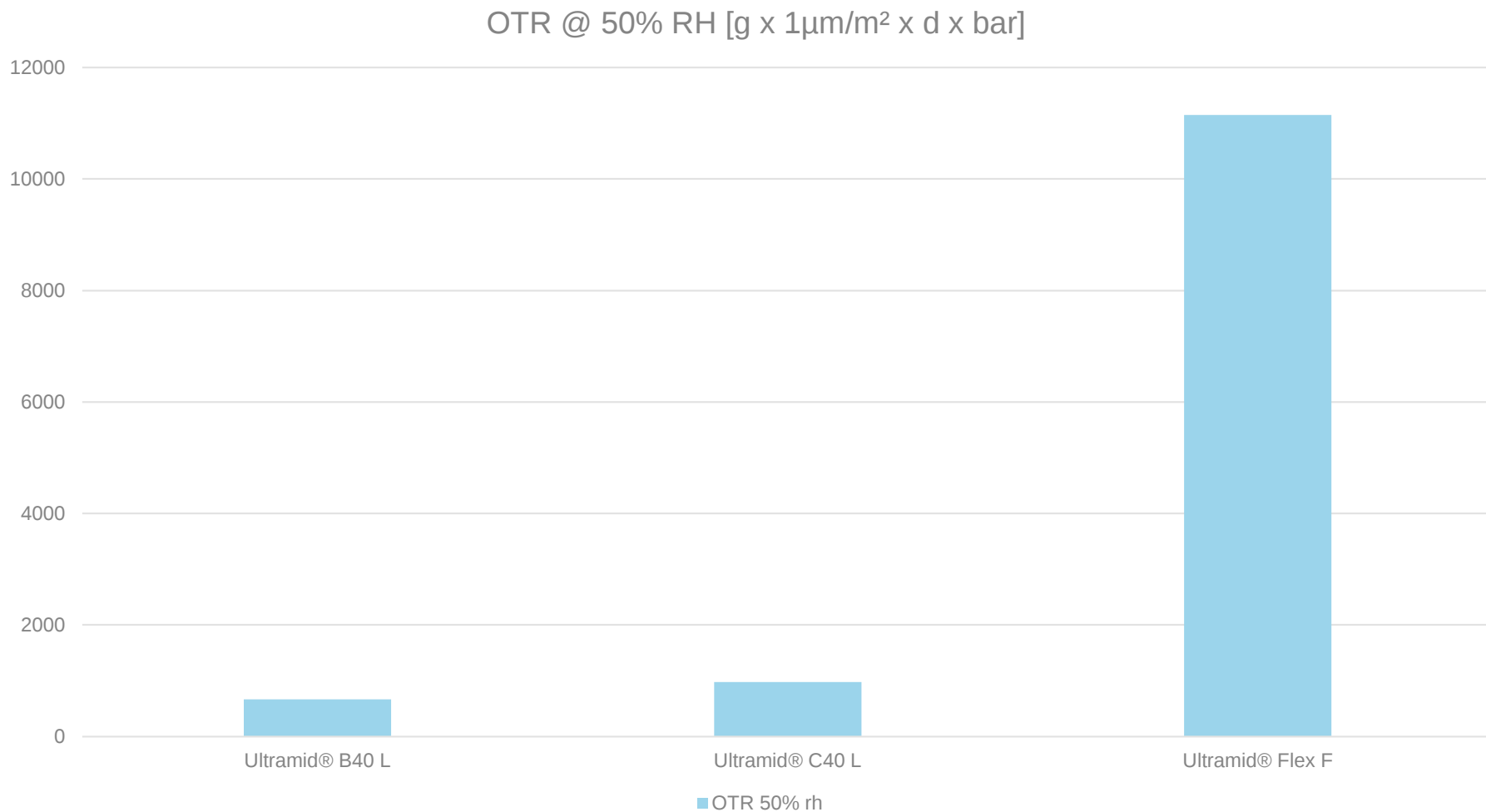
Haze is nearly non-existent (0.3%!)



It's even possible to see clearly through 3" of film

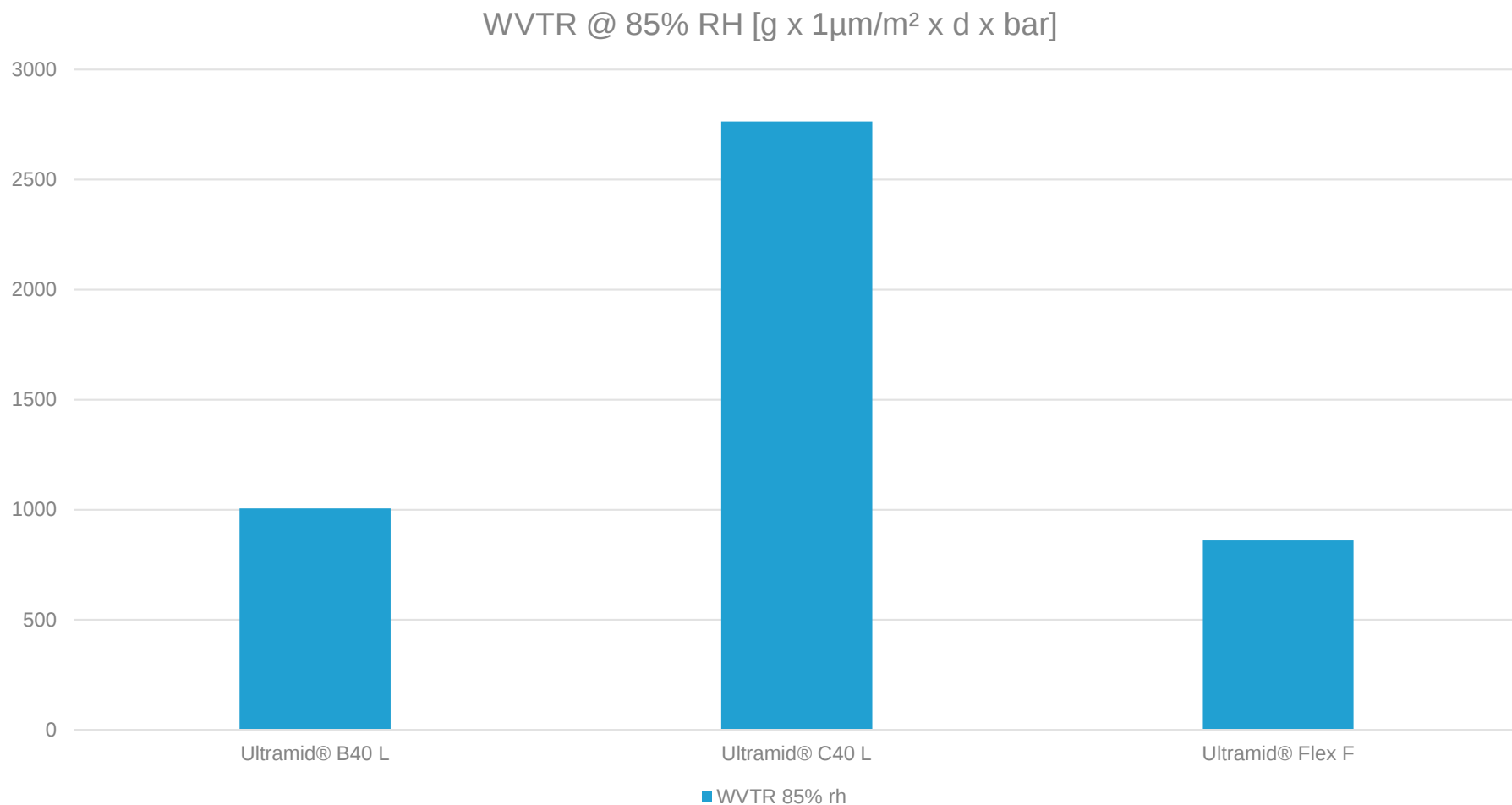


OTR is still 10x lower than PE



ASTM F1249, ASTM D3985-05, ISO 15105-1; 100µm monolayer blown film

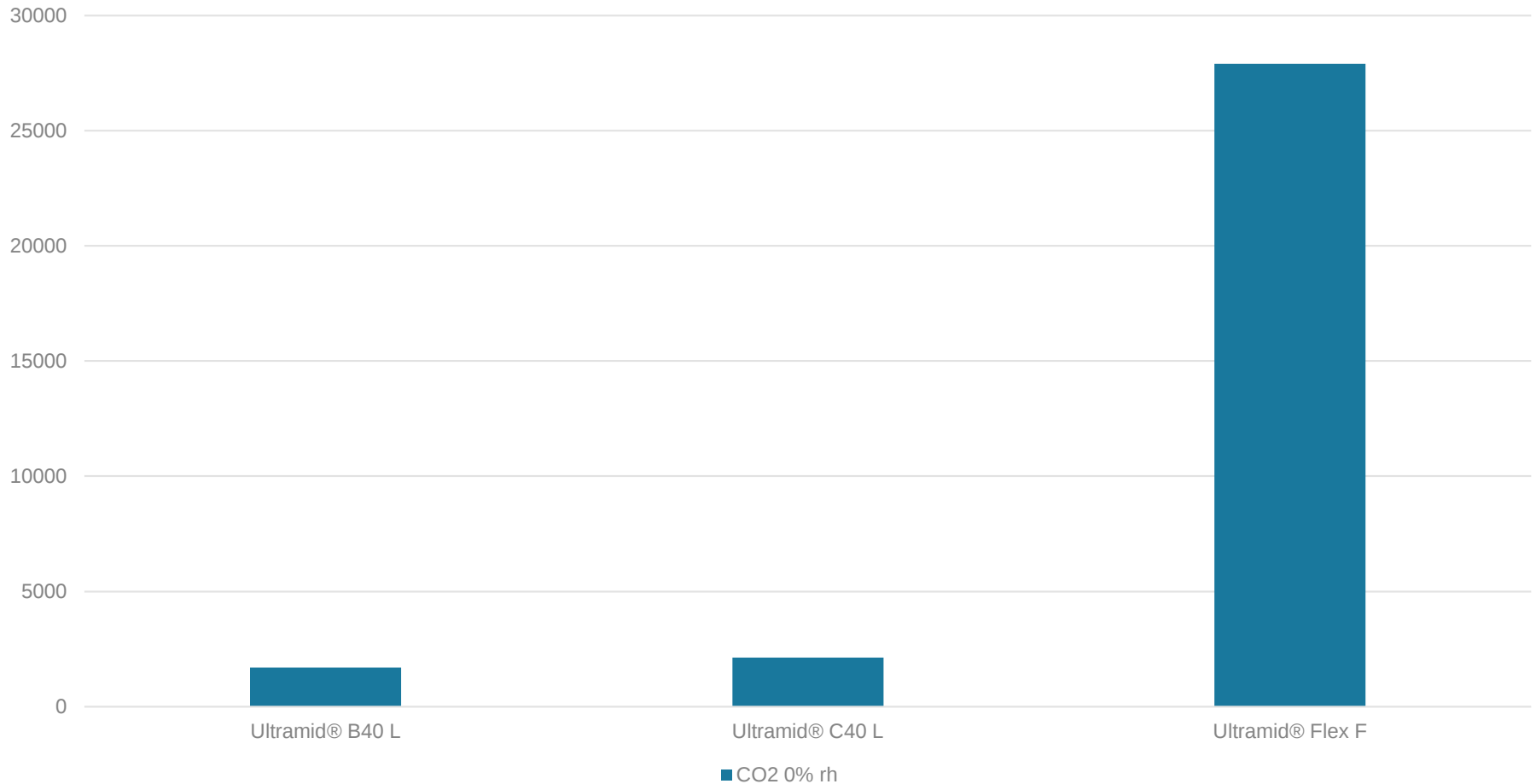
WVTR is lower



ASTM F1249, ASTM D3985-05, ISO 15105-1; 100µm monolayer blown film

CO₂ barrier allows for excellent breathability

CO₂ Transmission @ 0% RH [g x 1µm/m² x d x bar]



ASTM F1249, ASTM D3985-05, ISO 15105-1; 100µm monolayer blown film

Where does this new class of PA belong?

- Tear Resistant
- Softer
- Puncture Resistant
- Extreme Clarity
- Partially Bio-based
- Chemically Resistant
- Formable
- Unique balance of barrier properties



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