Thermoforming Enhancements with Cyclic Olefin Copolymers

Why Use TOPAS® COC in Thermoforming

- Improve many physical properties
- Impart new functionality, such as barrier & heat resistance; and capability, such as deep draw
- Improve material distribution & uniformity in formed article
- Improve package performance & durability
- Enable downgauging to satisfy source reduction initiatives
- Reduce cost of forming film

Formed Cavities: 8007 & Octene LLDPE

0 10 15 20 30 % COC

Incremental addition of TOPAS® COC clearly shows progressive improvement in appearance

TOPAS® COC: Forming Film Performance

Forming Films: Why add TOPAS® cyclic olefin copolymer?

- **vs. Nylon-based films**
  - improved formability, reclaiming
- **vs. Ionomer films**
  - improved cost, stiffness, optics
- **vs. Polyolefin films**
  - improved forming, stiffness

TOPAS® COC – an amorphous polyolefin bringing unique forming benefits

TOPAS® COC

Thermoforming Applications

TOPAS® Cyclic Olefin Copolymer (COC)

Your Clear Advantage.

TOPAS® COC – Forming Film Enhancement

Description:

Medical and Food Forming Films with LLDPE/COC blends or multilayered films

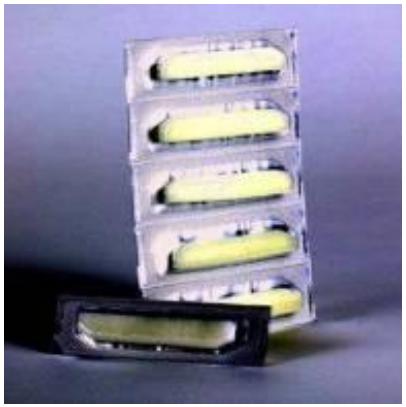
Value Proposition:

- Good forming properties
- Excellent dimensional stability
- Excellent stiffness
- Reclaimable for cost-effectiveness

TOPAS Grades:

8007F-600, 9506F-500

Dental Blister



Description:
Tooth whitener refill sponge container

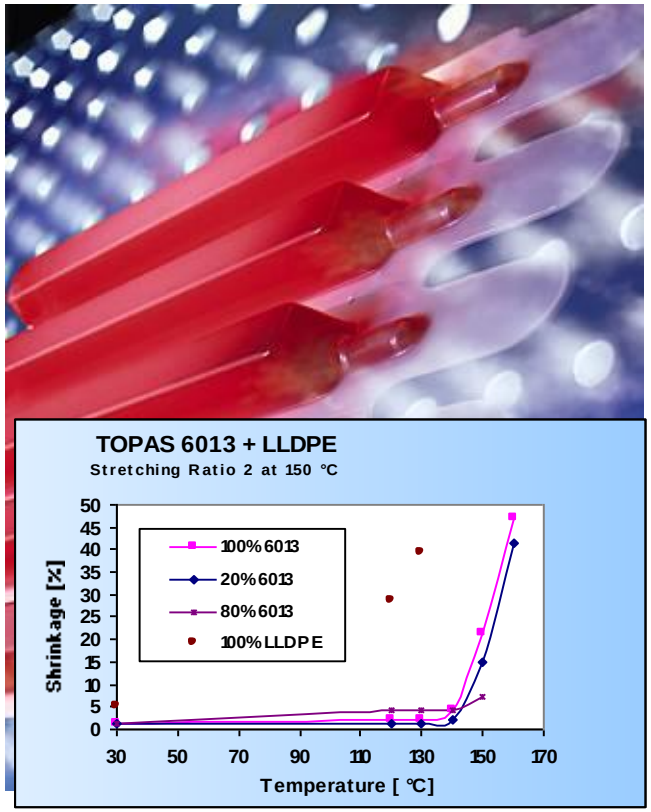
Value Proposition:

- Peroxide resistance
- High moisture barrier
- Long shelf life
- Easy thermoforming
- Oxygen barrier layer can be added
- Light resistance available with opaque film

TOPAS Grade:
8007F-04

Converter:
Tekni-Plex

Steam Sterilizable Blister



Description:
Post-sterilizable forming film
Monolayer film (COC-rich blend)

Value Proposition:

- No shrinkage and distortion of blister film during steam sterilization (121°C/ 20min)
- High moisture barrier
- Excellent forming and die cutting behavior
- Polyolefin solution

TOPAS Grade:
6013F-04

Converter:
Advance Technology

TOPAS® COC Benefits For Thermoforming

- Improve thermoformability & enhance package integrity with less gauge variation & good dimensional stability
- Enable downgauging to reduce material cost
- Improve most physical properties, including stiffness, strength, impact resistance & optics
- COC benefits from orientation during forming more than other polyolefins
- Design recommendations:
  - LLDPE – No restrictions
  - LDPE – Minimize in LLDPE-COC blends

TOPAS® COC

Benefits of Discrete COC Layers in Thermoforming

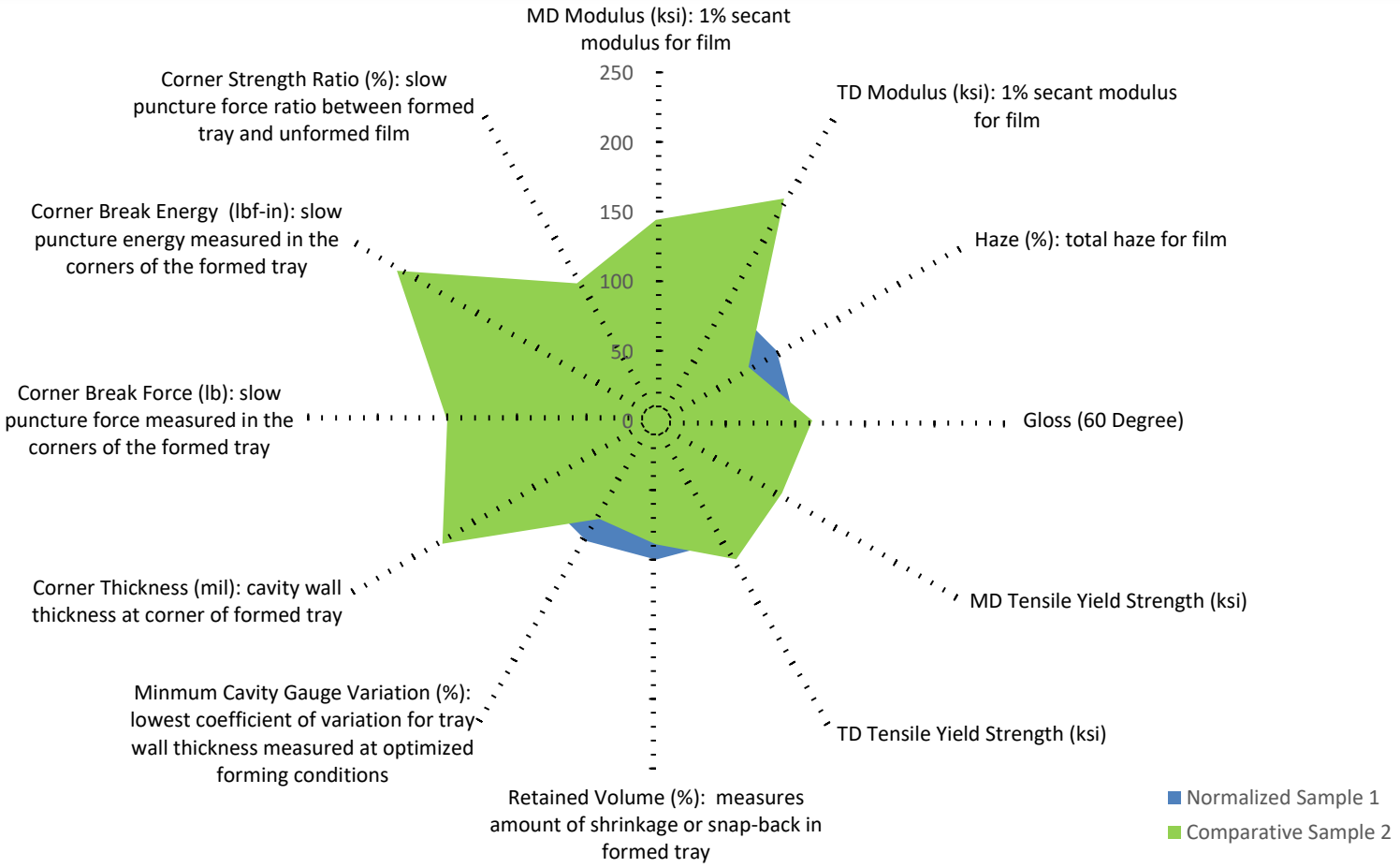
TOPAS® Cyclic Olefin Copolymer (COC)
Your Clear Advantage.

6-mil Cast Film Structures

COC	Monolayer	Multilayer
10	90% o-LLDPE (0.920 g/cc, 1.0 dg/min) 10% 8007	A: 44.5% (2.7 mil) o-LLDPE B:11% (0.6 mil) 100% 8007 A: 44.5% (2.7 mil) o-LLDPE
15	85% o-LLDPE (0.920 g/cc, 1.0 dg/min) 15% 8007	A: 42.5% (2.55 mil) o-LLDPE B:15% (0.9 mil) 100% 8007 A: 42.5% (2.55 mil) o-LLDPE
20	80% o-LLDPE (0.920 g/cc, 1.0 dg/min) 20% 8007	A: 40% (2.40 mil) o-LLDPE B:20% (1.2 mil) 100% 8007 A: 40% (2.40 mil) o-LLDPE

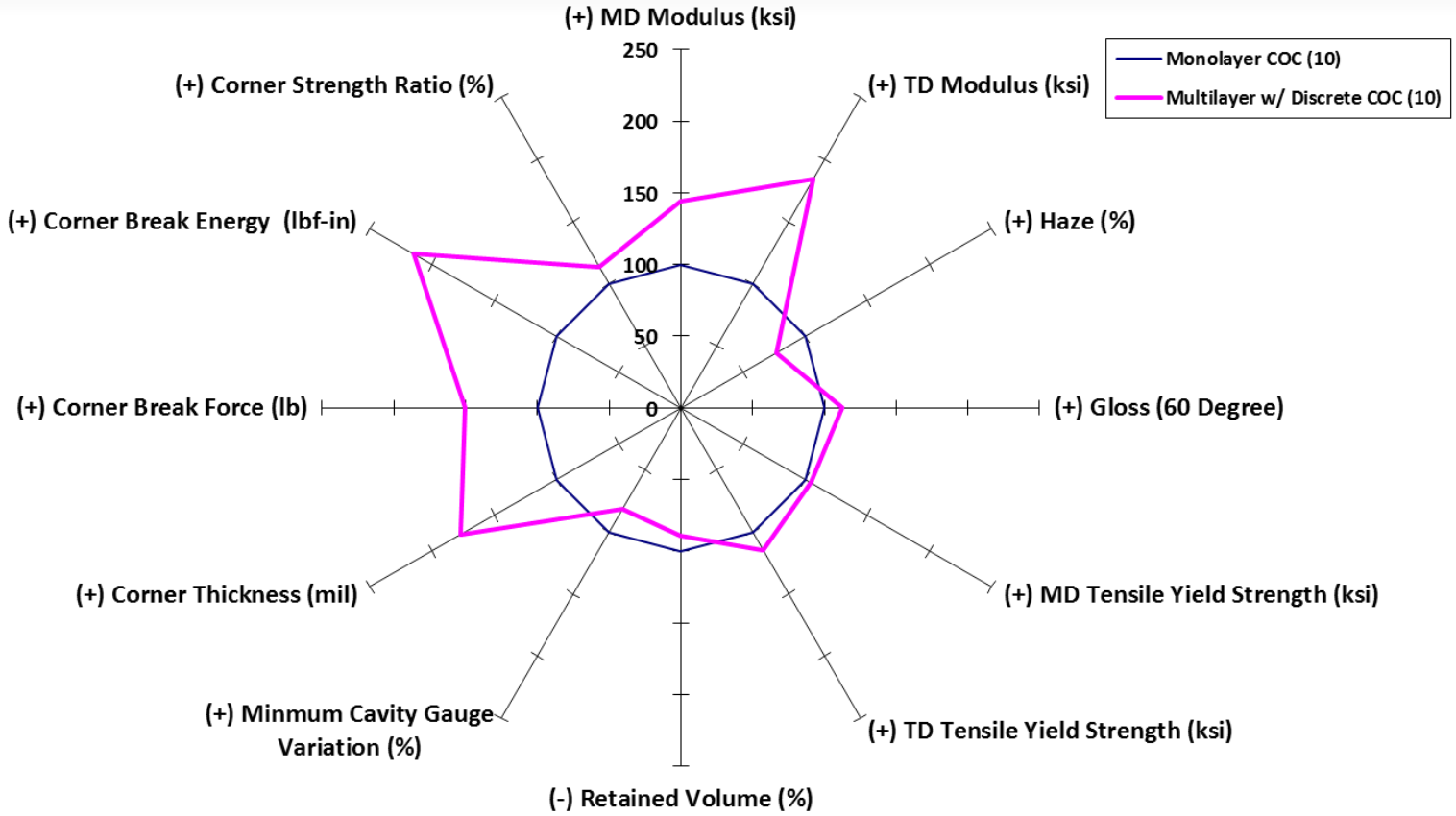
Equivalent COC content

Radar Plot Layout & Property Description



All samples are compared to a "control" film whose properties are normalized at 100. Positive or negative property differences are denoted by "+" or "-"

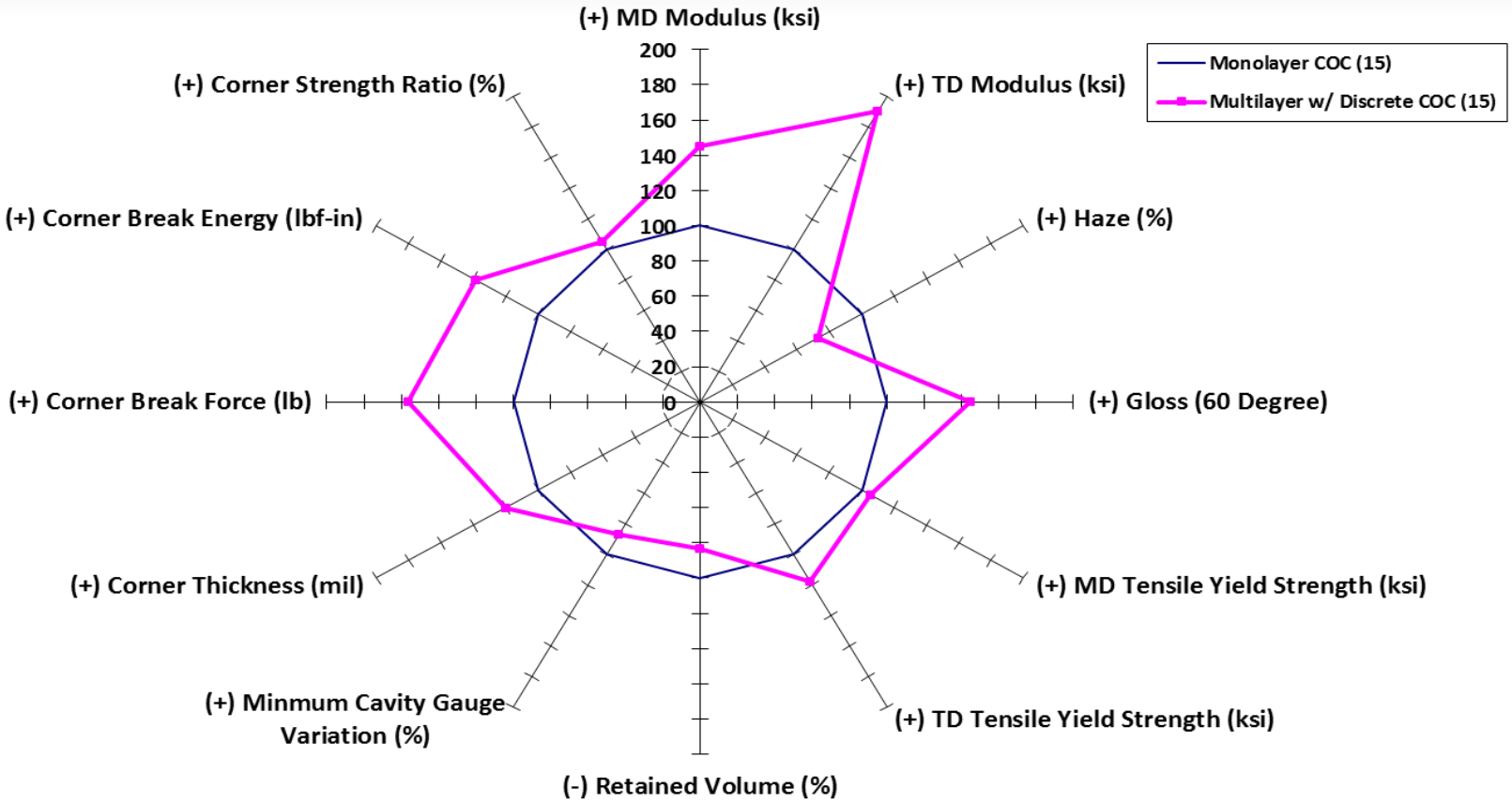
10% COC Monolayer vs. 10% COC Multilayer



10% COC discrete layer construction offers "free" improvement to many properties vs. 10% monolayer blend

Best enhancements: Formed Tray Corner Puncture

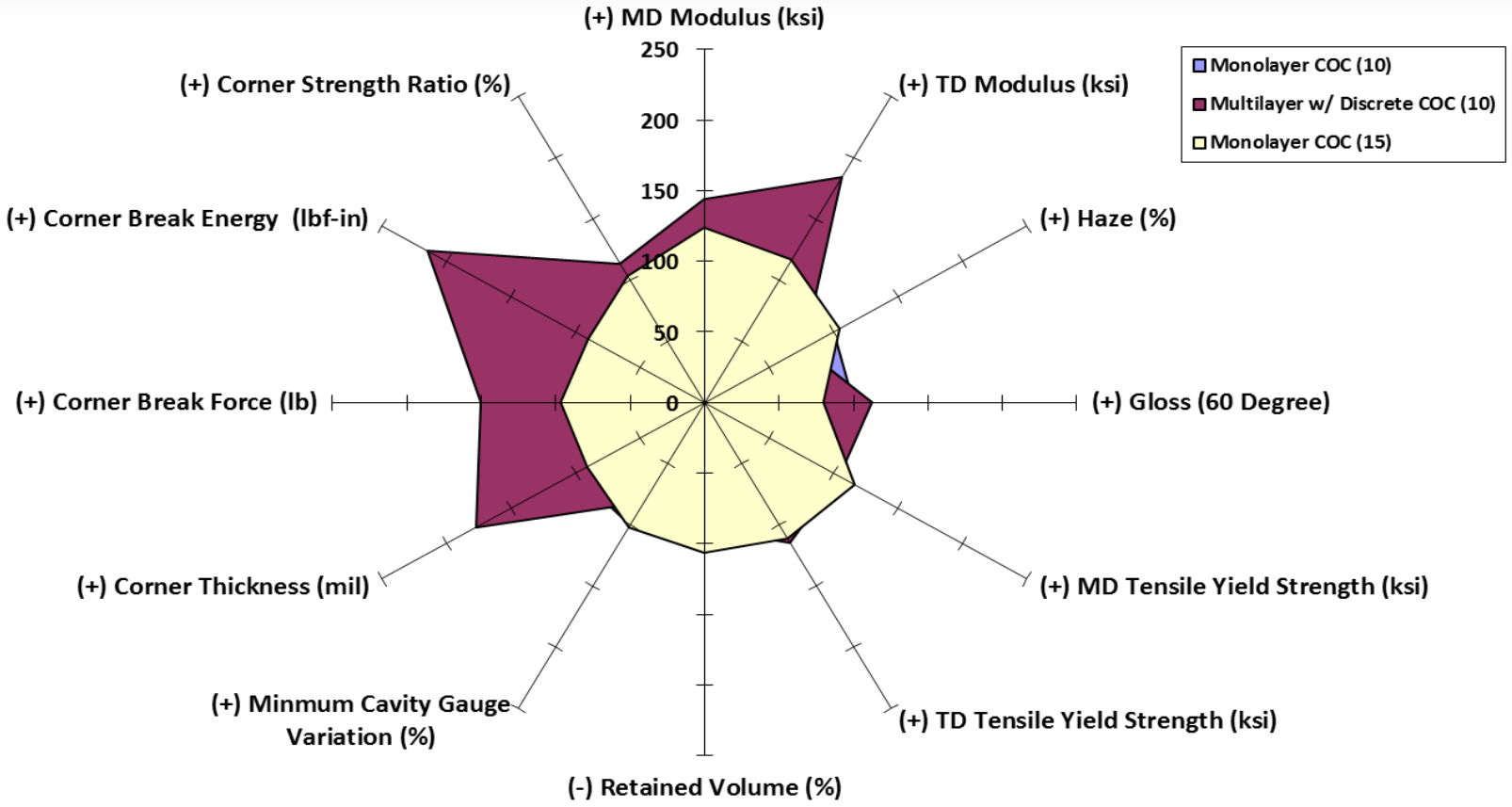
15% COC Monolayer vs. 15% COC Multilayer



15% COC discrete layer construction offers "free" improvement to many properties vs. 15% monolayer blend

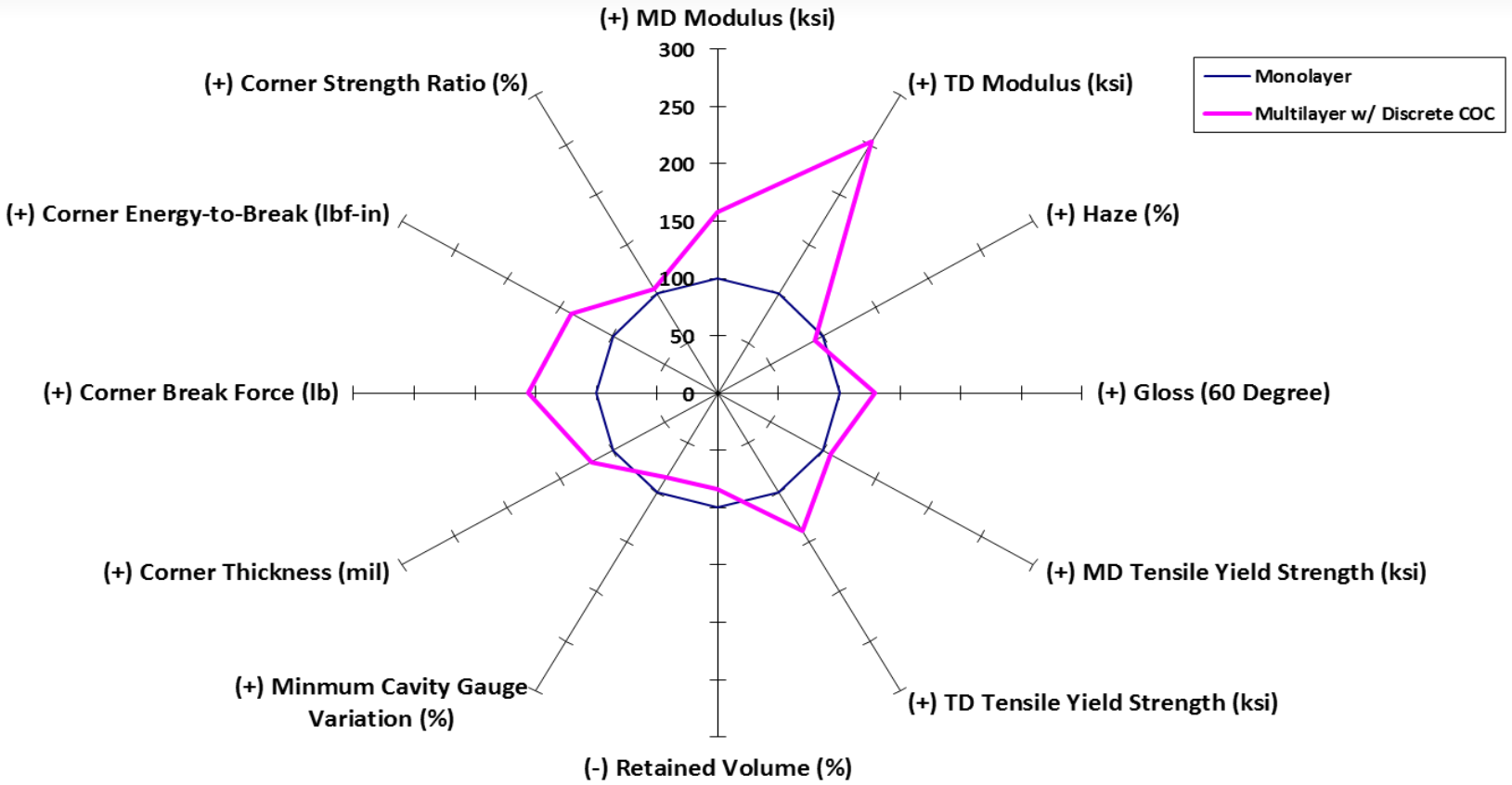
Best enhancements: Modulus & Formed Tray Corner Puncture

10 & 15% COC Monolayer vs. 10% COC Multilayer



10% COC discrete layer construction offers <u>cost savings</u> improvement to many properties vs. 10% & 15% monolayer blend
Best enhancements: Modulus, and Formed Cavity Corner Puncture

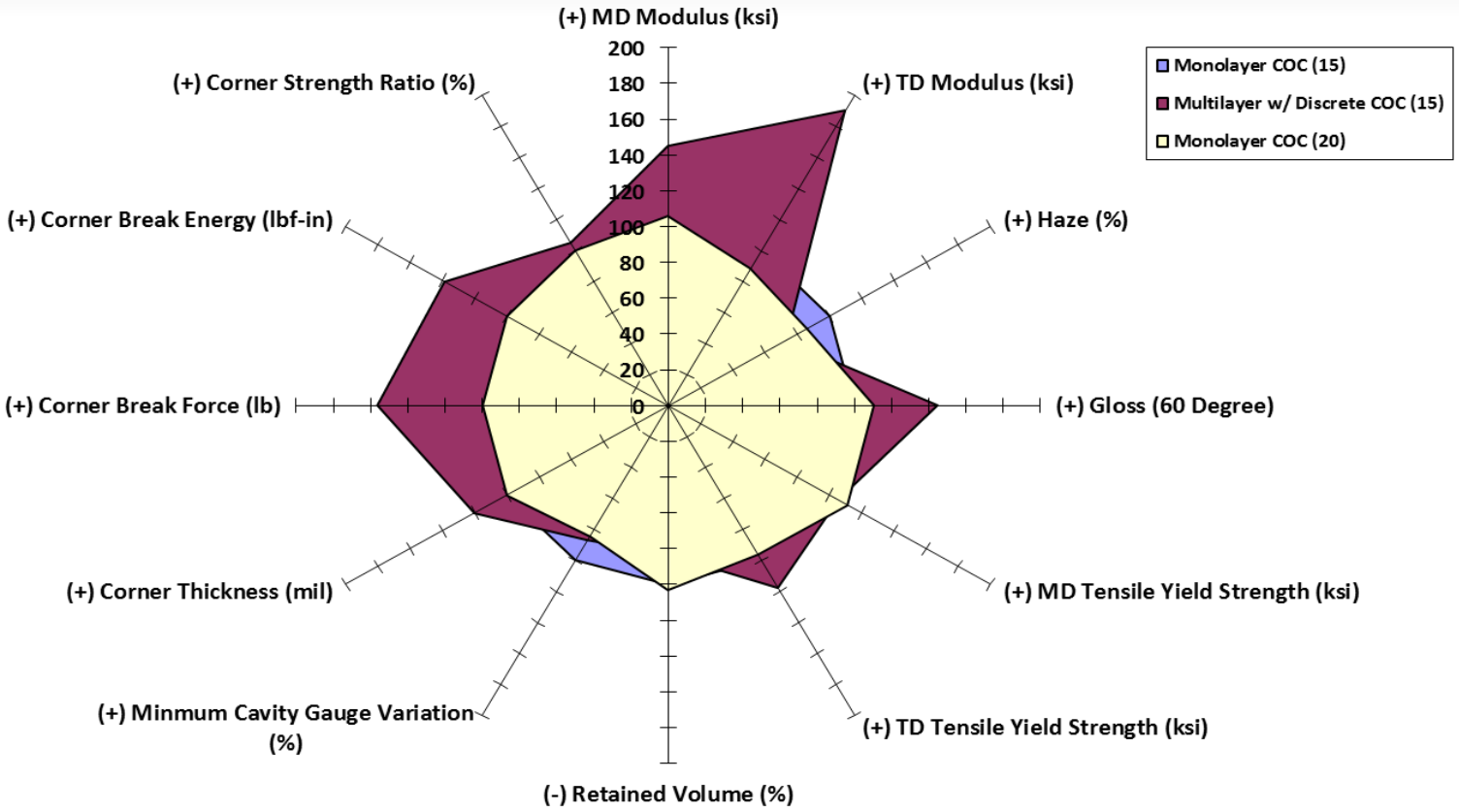
20% COC Monolayer vs. 20% COC Multilayer



20% COC discrete layer construction offers "free" improvement to many properties vs. 20% monolayer blend

Best enhancements: Modulus, Tensile & Formed Tray Corner Puncture

15 & 20% COC Monolayer vs. 15% COC Multilayer



15% COC discrete layer construction offers cost savings improvement to most properties vs. 15% & 20% monolayer blend

Best enhancements: Modulus, and Formed Cavity Corner Puncture

Forming Benefits With Discrete COC Layers

- Flat film enhancements include stiffness, strength and optical properties
- Thermoformed tray enhancements include puncture resistance, corner thickness & reduced gauge variation
- Films with discrete layers of COC can reduce material cost without sacrificing performance
- Films with discrete layers of COC have better barrier properties

Maximize cost-benefit ratio and film performance

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