2026

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Milliken`s Additive Solutions for PP PCR

Min Shuncheng

Milliken Senior technical Manager
Shuncheng.min@milliken.com

AGENDA

- Brief introduction of Millad NX8000 clarifier and Hyperform HPN nucleator
- Case sharing of Milliken's PP PCR solutions
- Milliken`s latest 5th generation clarifier: Millad ClearX™ 9000 and value proposition in clarified PP PCR
- More PCR solution for PP Impact Copolymer(ICP)-Performance modifier Deltamax®

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Milliken

Millad® NX 8000: The Milliken clarification Solution

Millad NX 8000 became the benchmark in Clear polypropylene across the globe



Higher clarity & gloss

Tunable levels of clarity

10% lower cycle time, 10% faster productivity,

10% Energy saving, 10% carbon emission reduction

UL green label

Elimination of yellowness in parts

Lower risk of white specks, voids, and other defects

Supply assurance

Food package

Medical app.

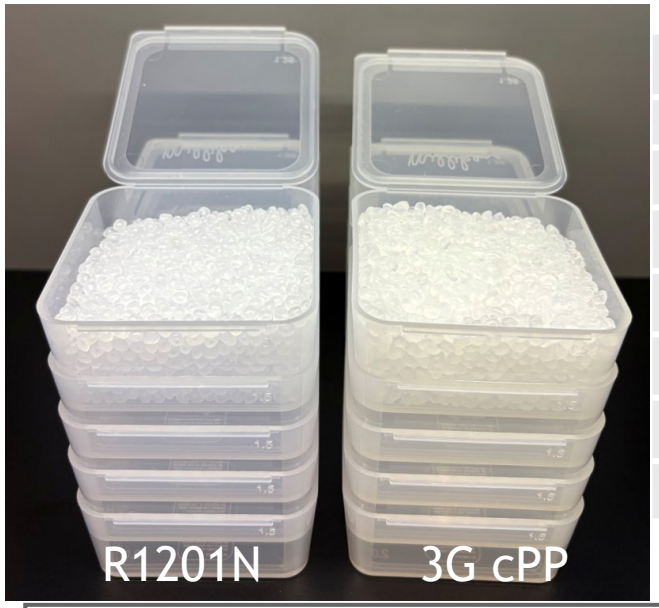
Consistent shrinkage, stiffness & impact

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Energy saving trial

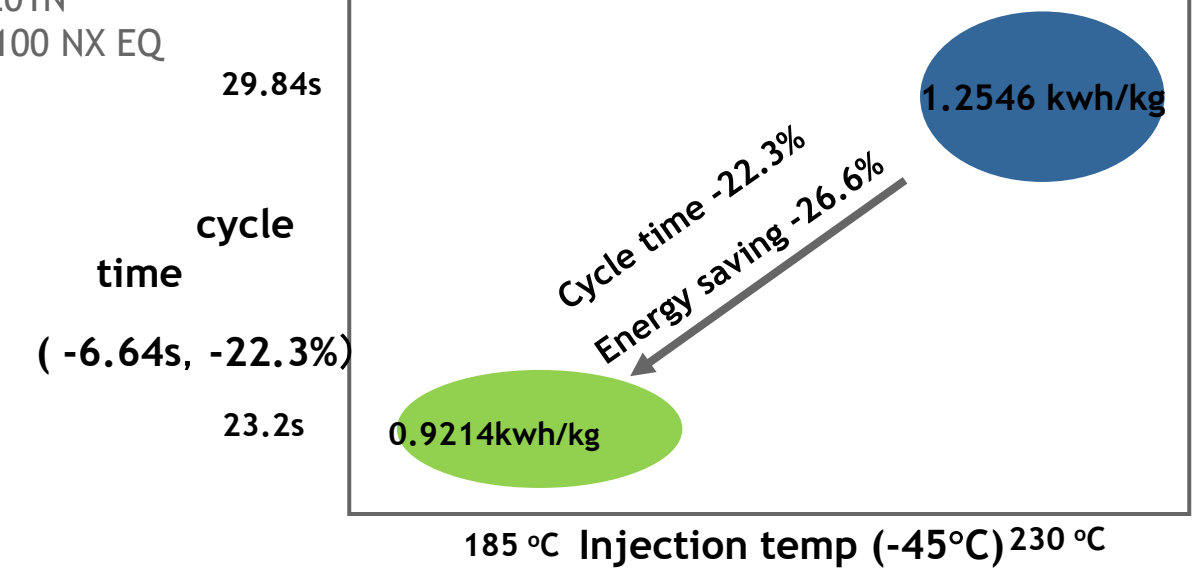


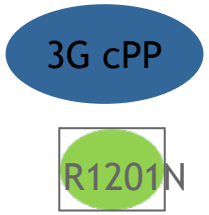
V68MO MI30 3G cPP



R1201N MI100 NX EQ

Part	Mini VTC
Machine	Hydraulic
Reference Resin	MFR30 3G clarified PP
NX8000 PP	MFR100 NX8000K EQ
Part/Shot Weight	26.7g
Energy Saving	333.2KWH/1MT PP
Machine cost	to be confromed
Labour cost	to be confirmed





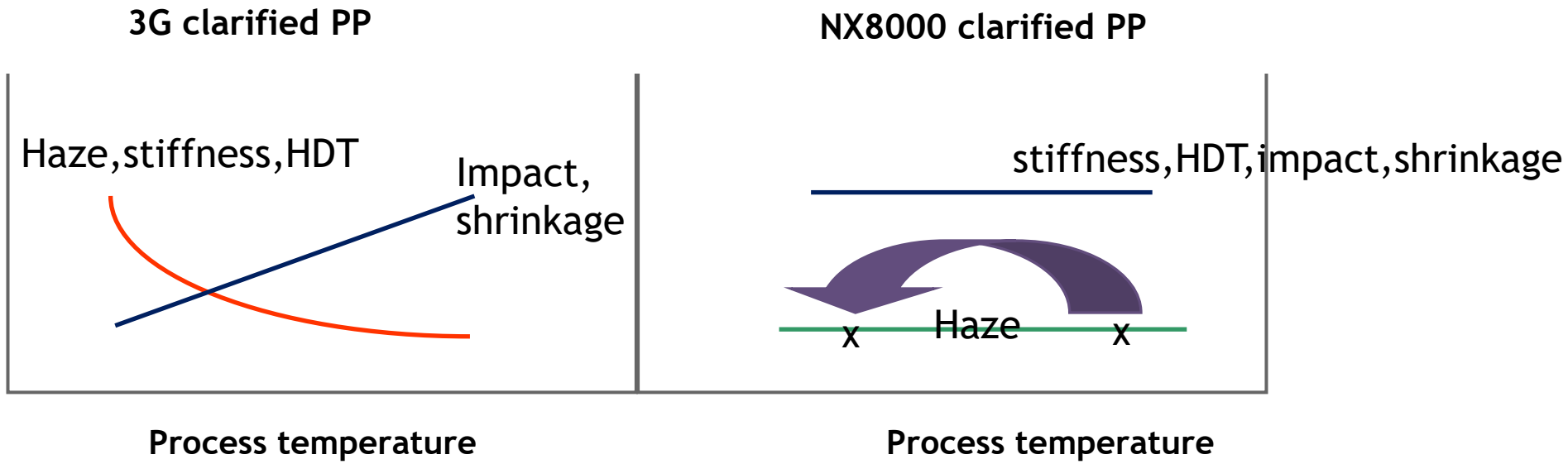
Processing traditional clarified PP unit energy consumption

Processing NX8000 clarified PP unit energy consumption (kwh/kg)

- Visually MI100 NX EQ showed less yellowish, fresher, clearer
- more than 25% less carbon emission

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The Benefits of NX8000 vs 3G clarified PP





Shrinkage Voids when used 3G clarified PP to produce storage box

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Conversion from 3G clarified PP to NX8000 clarified PP
(R601N,R701N,R801N,R901N,R1001N,R1101N,R1201N)



- Higher compounding productivity without quality issue (PP producers)
- Injection temperature reduced by 30°C-50°C (downstream)
- Energy Saving &Cycle time reduction（10%-25% for downstream）



- Improve profits (potentially more than USD100/T cost saving)
- Consistent quality, free of defects



- Reduce carbon emissions and air pollution



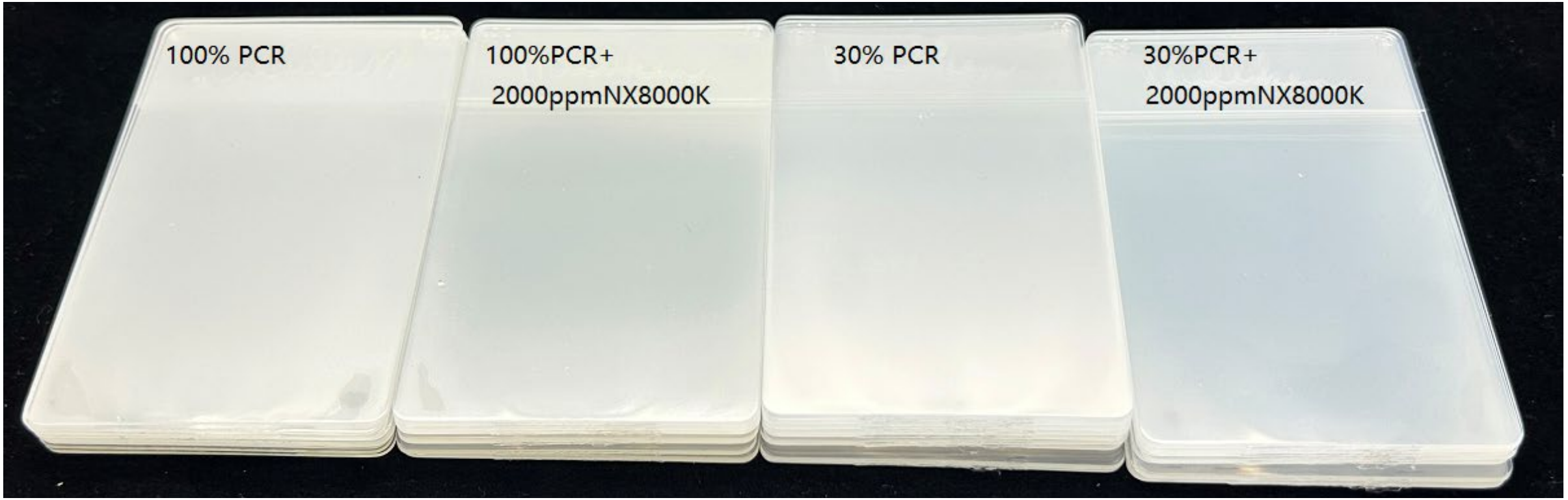
- Promote the company’s sustainability
- Helps develop market

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PCR Case study:
Clarity and quality improvement by NX8000 technology

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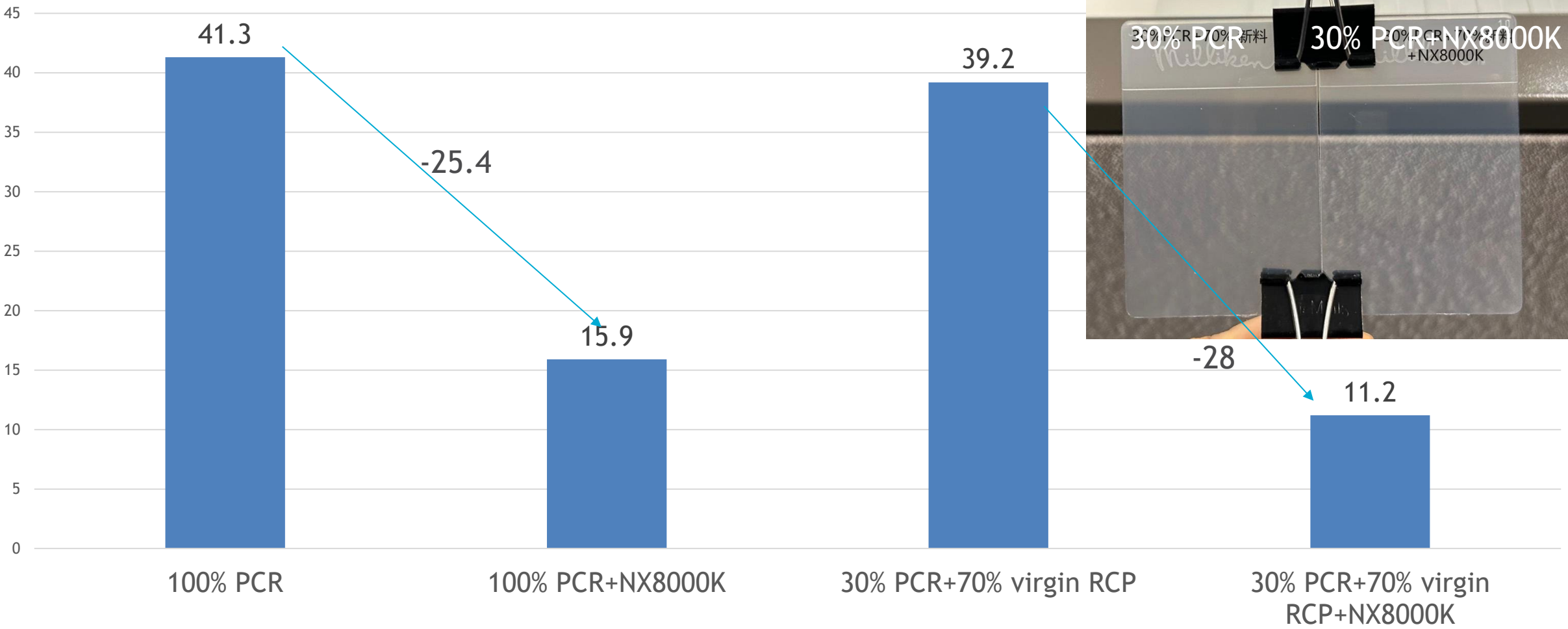
Appearance



- 100% PCR (nature color) showed yellowish color. When formulated with 2000ppm NX8000K via MB, the plaque color became bluish.
- 30% PCR showed yellowish color to some extent. When formulated with 2000ppm NX8000K via MB, the plaque color became bluish.

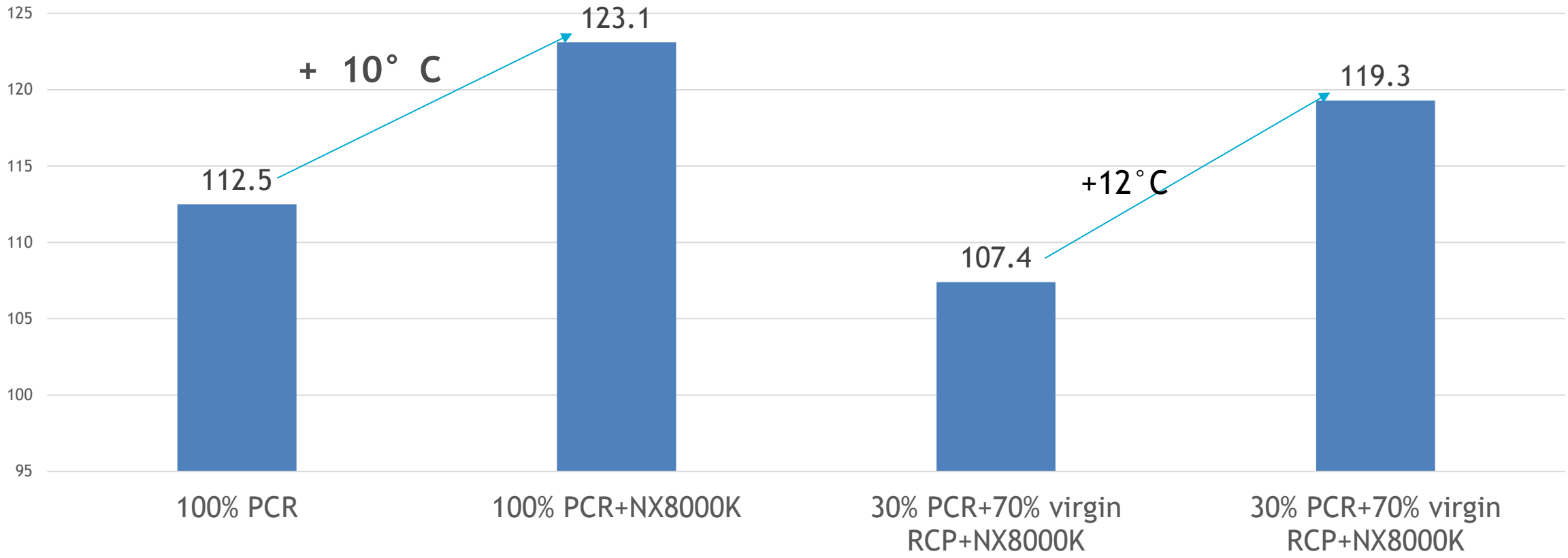
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1mm plaque haze



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Tc (Crystallization temperature)

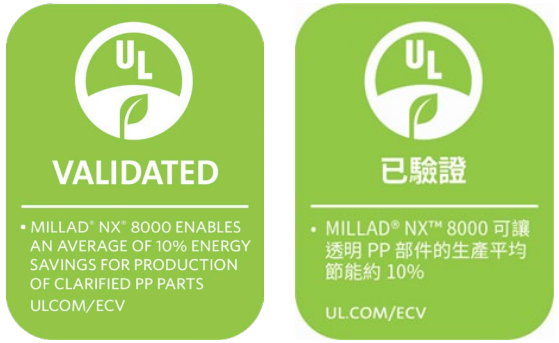


NX8000K increased Tc by more than 10C, finished product solidified at higher temperature, i.e. potentially shorten cycle time and improve productivity.

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Value Proposition of NX8000 in transparent PCR

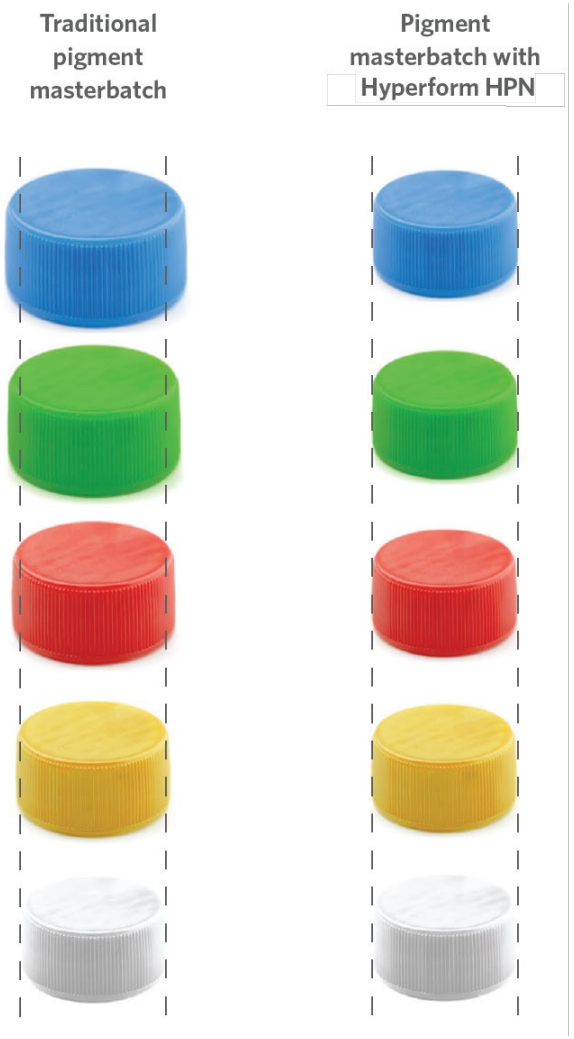
- Reduced haze, improved transparency
- Yellowness reduction, enhanced esthetical
- Higher Tc, cycle time reduction
- Better clarifier dispersion leading to low processing temperature, further productivity improvement
- Free to apply for UL eco label, aligning with **sustainability** practice

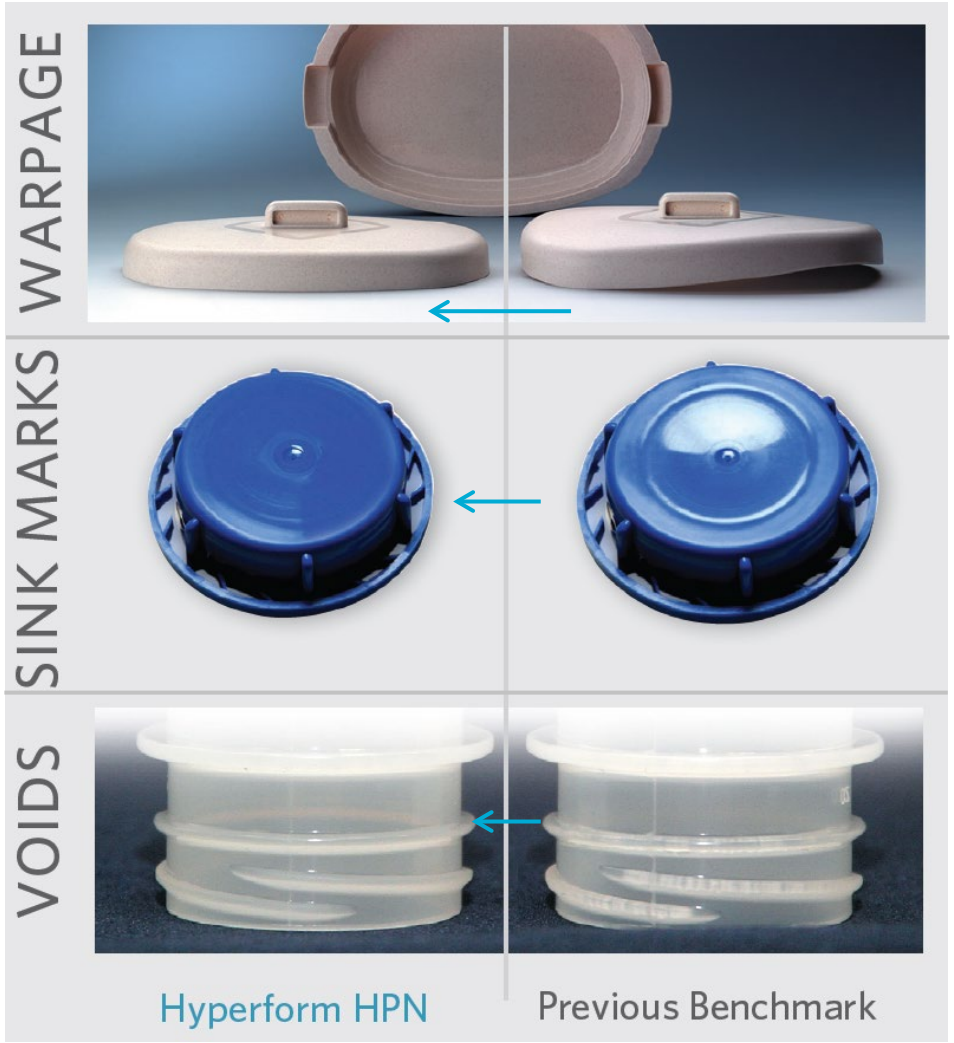


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Nucleating Agents – Hyperform® HPN® Series

HYPERFORM SERIES ARE TOP TIERS NUCLEATING AGENTS DESIGNED TO IMPROVE PARTS QUALITIES





VALIDATED

- MILLIKEN HYPERFORM® HPN PRODUCTS ENABLE 5% TO 8% ENERGY SAVINGS WHEN USED AS A NUCLEATOR FOR PRODUCTION OF THIN-WALL INJECTION MOLDED CONTAINER LIDS OR SIMILAR POLYPROPYLENE PRODUCTS

UL.COM/ECV

UL Green Label
Hyperform Grade
(J1105T,J1205T)

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Case study:
HPN technology enhance the appearance, physical properties and transparency of PCR

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Pellet Appearance

PELLET YI

Formulation	Pellet YI
100% PCR	24.8
30%PCR + virgin HPP	15.8
HPN-ei	3.5

PCR: MFR10, Food grade;natural color

Observations:

- 100% PCR Pellets look too yellow with naked eye
- Addition of 70% of the Virgin HPP reduced pellet YI
- Addition of HPN-ei reduced YI significantly and Pellets visual appearance closer to natural colors



100% PCR 30% PCR+70% virgin HPP HPN-ei

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1mm plaque haze and appearance



100%PCR 30%PCR+70% HPP 500ppm HPN-ei

SAMPLE ID	1mm Haze
PCR	NA
30%PCR + 70% HPP	51.8
500ppm HPN-ei	45.5 (- 6units)

Observations:

- Add 70% Virgin HPP reduced plaque yellowness
- 500ppm HPN-ei further reduces Plaque yellowness while reducing haze and improving overall clarity. This optical improvement could be enhanced by further finetuned HPN dosage and optimized compounding condition

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Other Physical properties

FM, HDT AND IZOD

SAMPLE ID	Flexural Modulus Mpa	HDT °C	Notched izod impact J/m
30%PCR + 70% Virgin HPP	1470	100.2	29.8
500ppm HPN-ei	1520 (+50Mpa,↑**4%**)	105.3 (**+5 °C**,↑5%)	32.5 (↑**9%**)

- 500ppm HPN-ei improved stiffness by +50Mpa, HDT by +5 °C, increased impact by about +9%
- The improvement could be enhanced by further finetune HPN-ei dosages and optimized compounding conditions

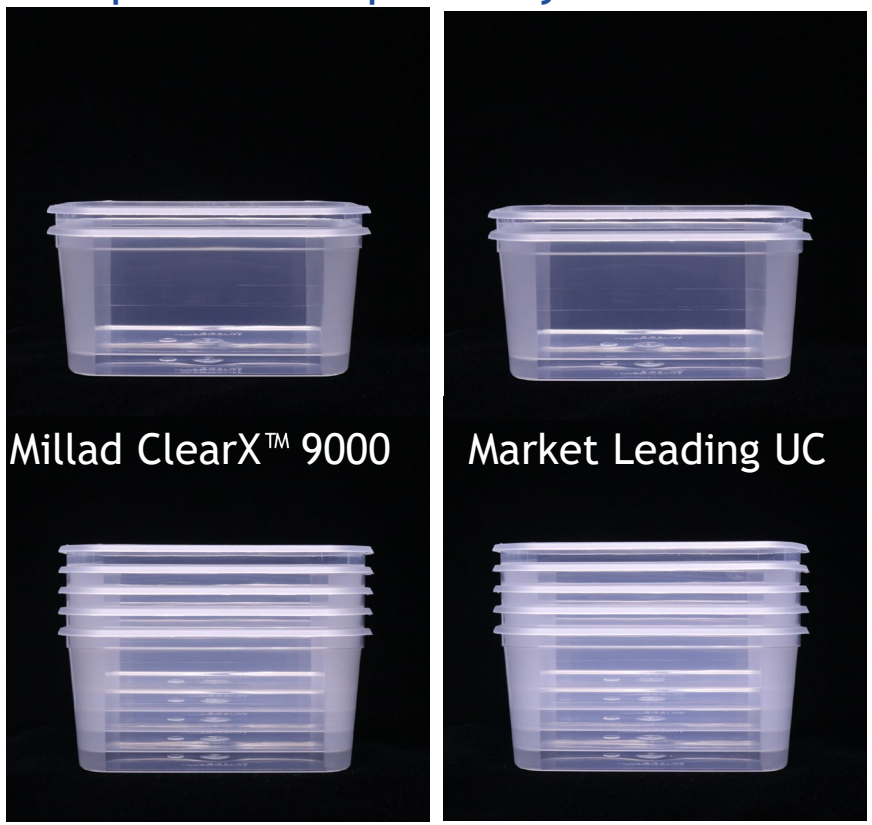
HPN-ei enhanced overall physical, optical properties and visual appearance of PCR

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Millad ClearX™ 9000 The Clear Choice for Polypropylene

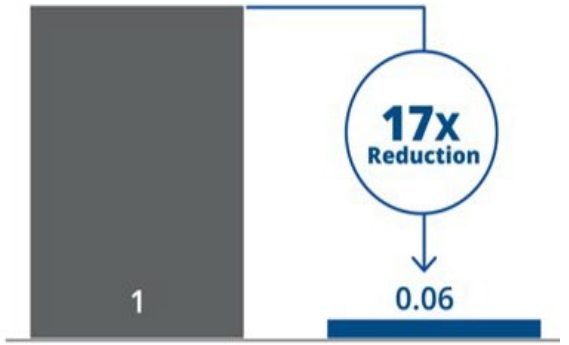
Increasing the Value of High Clarity Polypropylene

- Enhanced cPP clarity/Aesthetical
- Improved loading efficiency
- Reduced Extraction
- Enhanced Chemical Stability
- Improved Compatibility



Reduced extraction

Total Migration in Olive Oil



Market Leading Clarifier Millad ClearX™ 9000

According to FDA-2020-D-1925. Data normalized to 1 for Market Leading Clarifier

Broad use in food contact applications



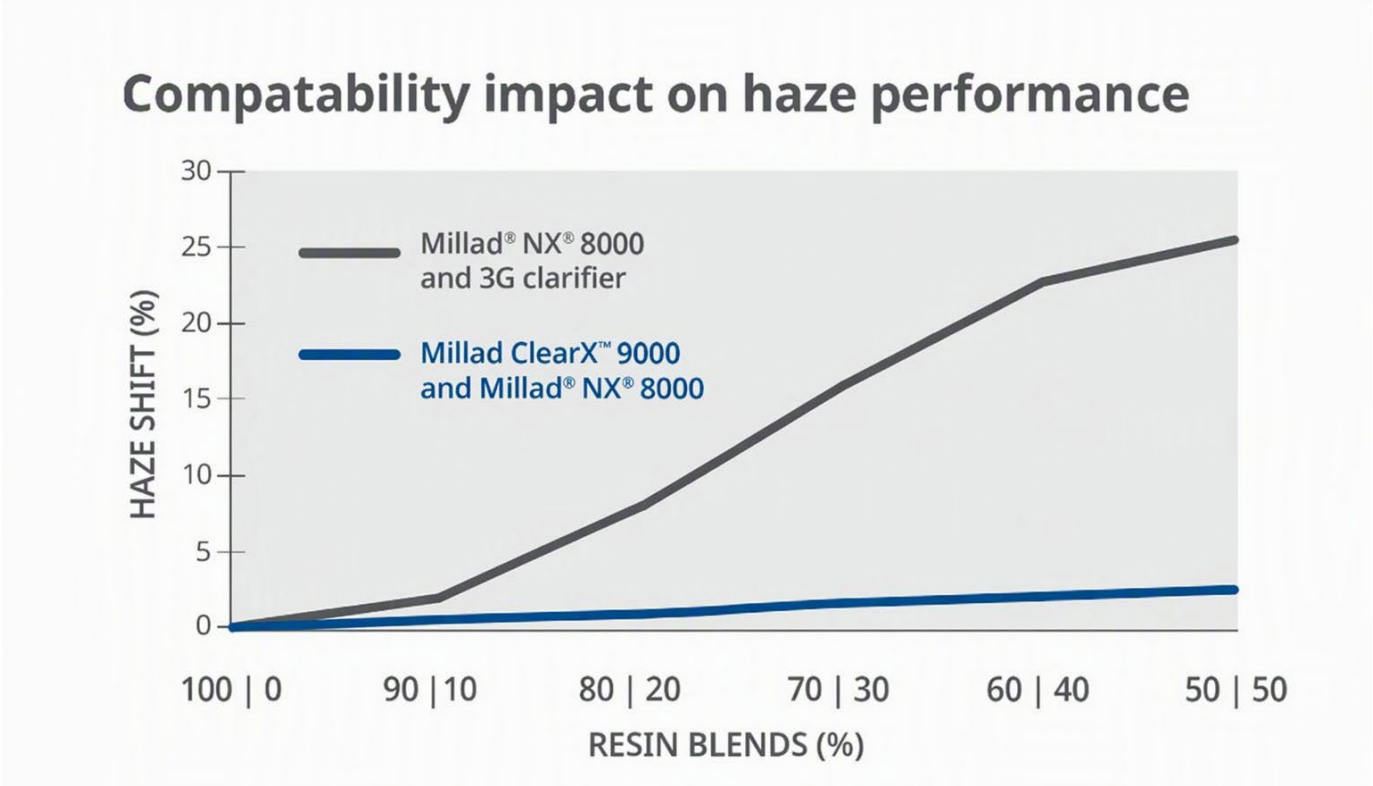
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Millad ClearX™ 9000 and Millad NX8000 demonstrate a superior level of compatibility than seen with NX8000 and 3G clarifiers

ENHANCED COMPATIBILITY

Helps with ***managing inventory*** among silos

Enables ***higher post-consumer recycled (PCR) content levels*** with blends containing clarifiers



Millad ClearX™ 9000 will remain UL certified, continuing the legacy of NX8000 as an energy efficient clarifying option

Current day with NX8000

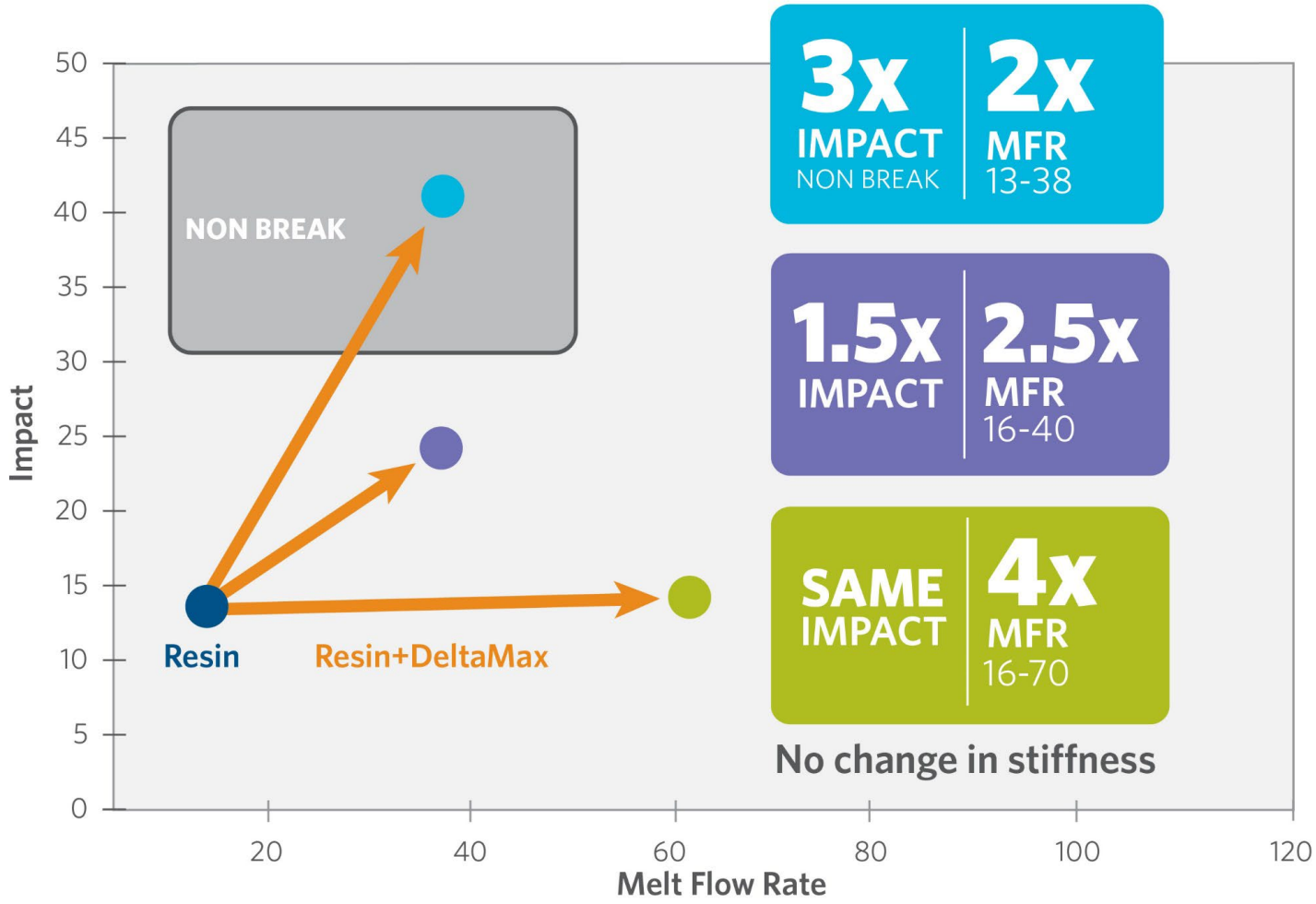


Future with ClearX 9000

Millad® ClearX 9000 will retain the same level of energy savings as NX8000 has shown vs prior generations

With the importance of green messaging, we have already begun the work for UL validation of ClearX 9000

Extend the performance boundaries of PP Impact Copolymers & ICP PCR



DeltaMax®
Performance modifier

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Milliken

DeltaMax Makes PP (ICP) PCR Better

MELT FLOW AND IMPACT CONTROL IMPROVES PP IN KNOWN PCR STREAMS

- Orange DeltaMax 3000i (m100)
  - Not food contact approved
  - Downstream

- White DeltaMax 5000a/T9
  - Food contact approved (T9)
  - Upstream & Downstream



DeltaMax | Commercial

DeltaMax Performance Modifiers for Increasing Volume of Recycled Raw Materials

CUSTOMER NEED : A polypropylene septic chamber manufacturer wants to incorporate more post-consumer recycled content into current rPP resin formulations to increase the volume of recycled raw materials and meet their corporate sustainability goals.

RESULTS : Using DeltaMax m100 at 1.5% LDR increased melt flow properties of the PCR polypropylene to equal to or better than existing resin formulations. By incorporating PCR with DeltaMax m100 into existing PP formulation, our customer was able to maintain product specifications and operational efficiencies.







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Constantly Creating. Advancing Circularity. Together.

