The Use of the Beta Nucleation to Improve the Properties and Lower the Cost of Polypropylene Geogrids

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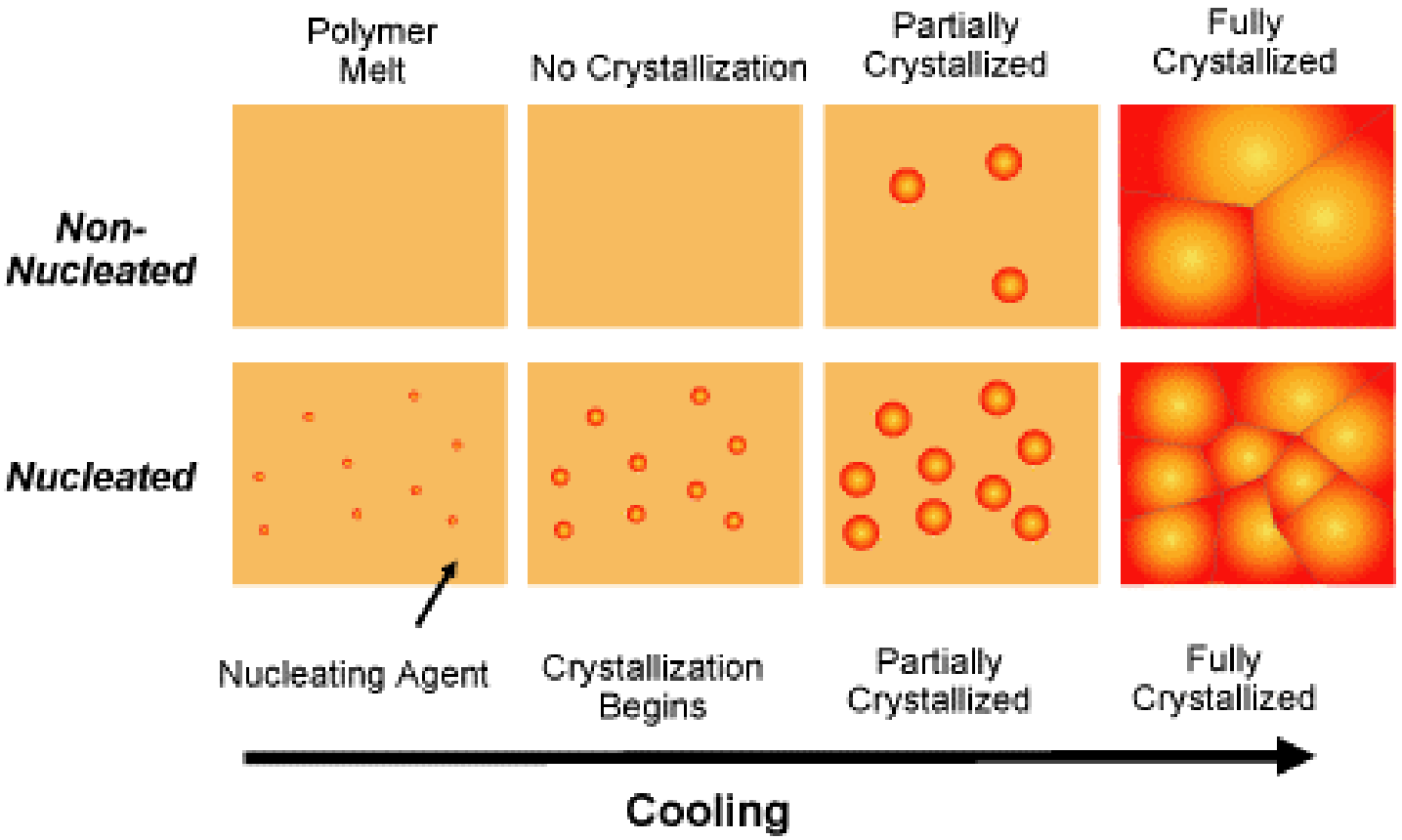
Outline

- **Introduction to Beta Nucleation in Polypropylene**
- **Effect of Beta Nucleation on Biaxial Geogrids**
- **Benefits of Beta Nucleation**

The Effect of Nucleating Agents in Polypropylene



Introduction

- **Polypropylene is a semi-crystalline polymer that has three different crystal forms (α, β, and γ)**
- **Nucleating agents (typically α-type) are added to PP to increase the rate of crystallization (faster cycle), improve stiffness & strength, and improve clarity.**
- **There are very few effective beta nucleating agents, and almost no commercial PP resins that are β-nucleated**
- **Beta nucleation can produce very unique PP products**
- **We have developed a β-nucleated masterbatch that can be added to any non-nucleated PP resin to achieve the benefits of beta nucleation.**

Differences Between Alpha and Beta Crystal Phases in PP

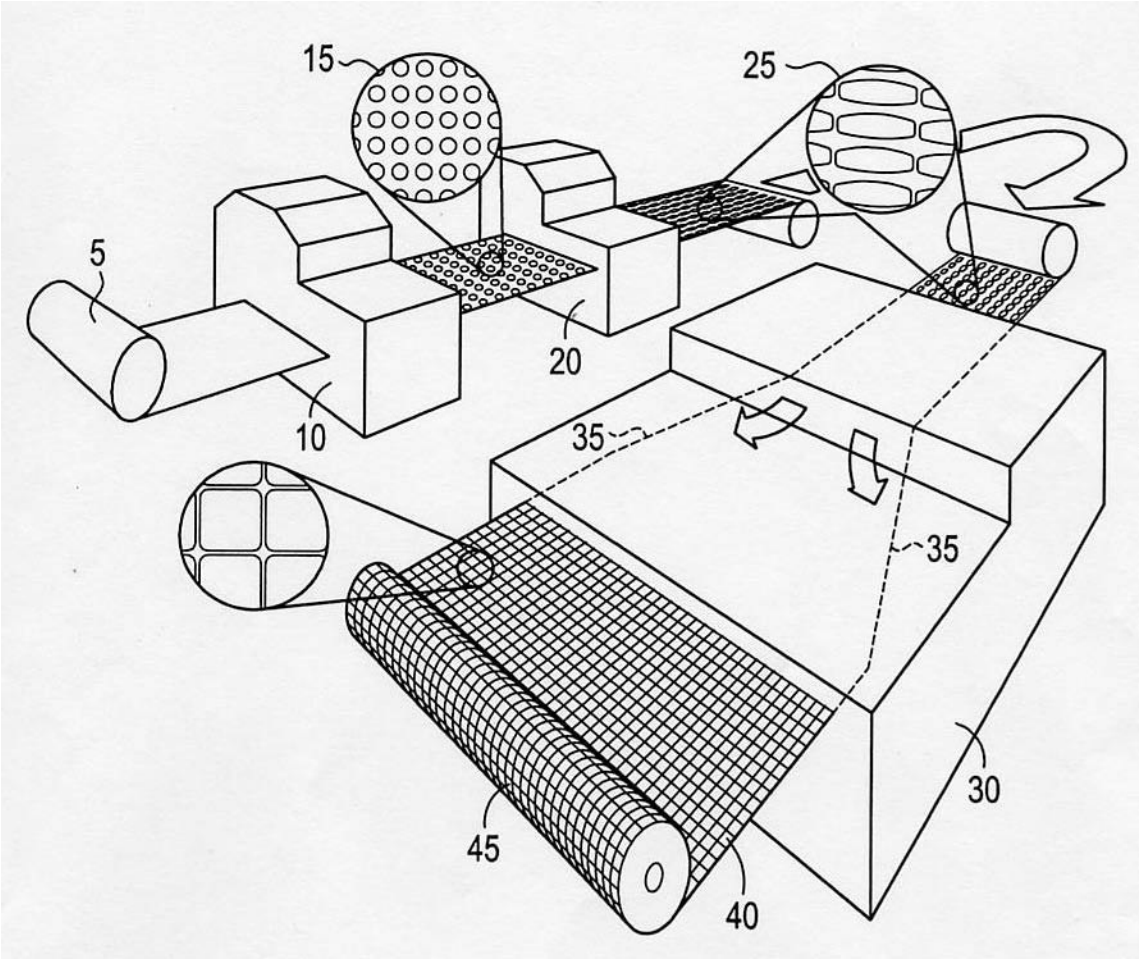
Alpha Phase

- Melts at ~ 164 ^{o}C
- Most common phase
- Many nucleants known

Beta Phase

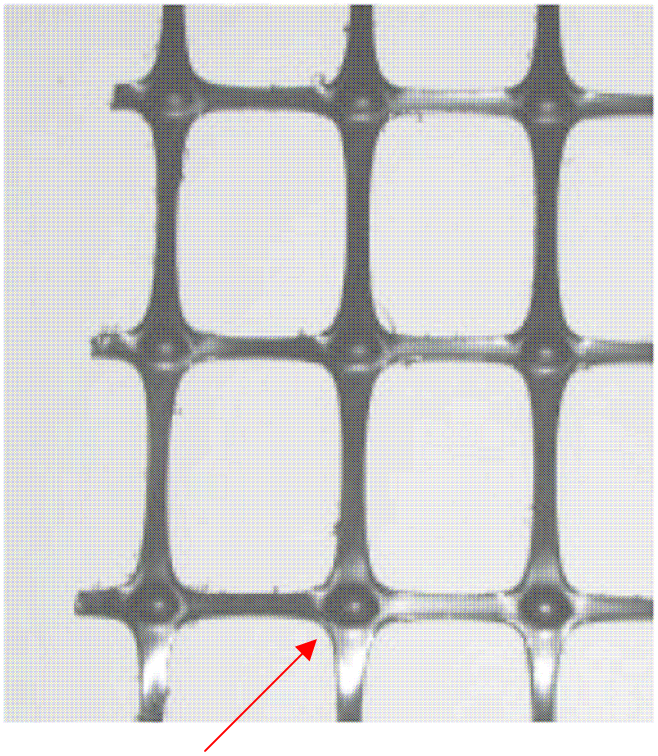
- Melts at ~ 150 ^{o}C
- More ductile phase – lower forces needed for stretching
- Transforms to alpha phase on stretching
- Undergoes more uniform drawing than alpha phase, and exhibits microvoiding

Geogrid Production Process



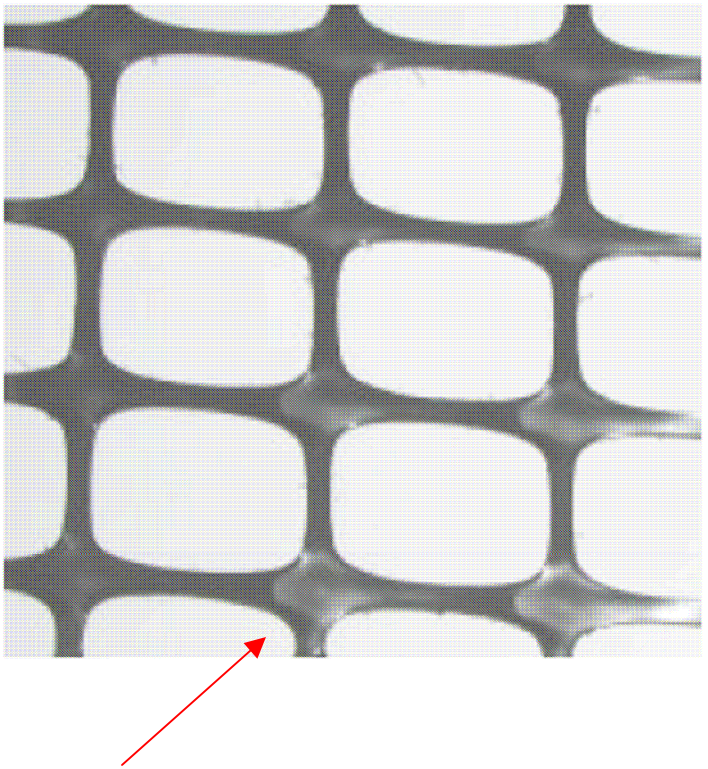
Geogrid Made With and Without The Mayzo Masterbatch

Control (non-nucleated)



Node thickness of 3.4 mm

Mayzo Beta-PP Masterbatch



Node thickness of 2.3 mm

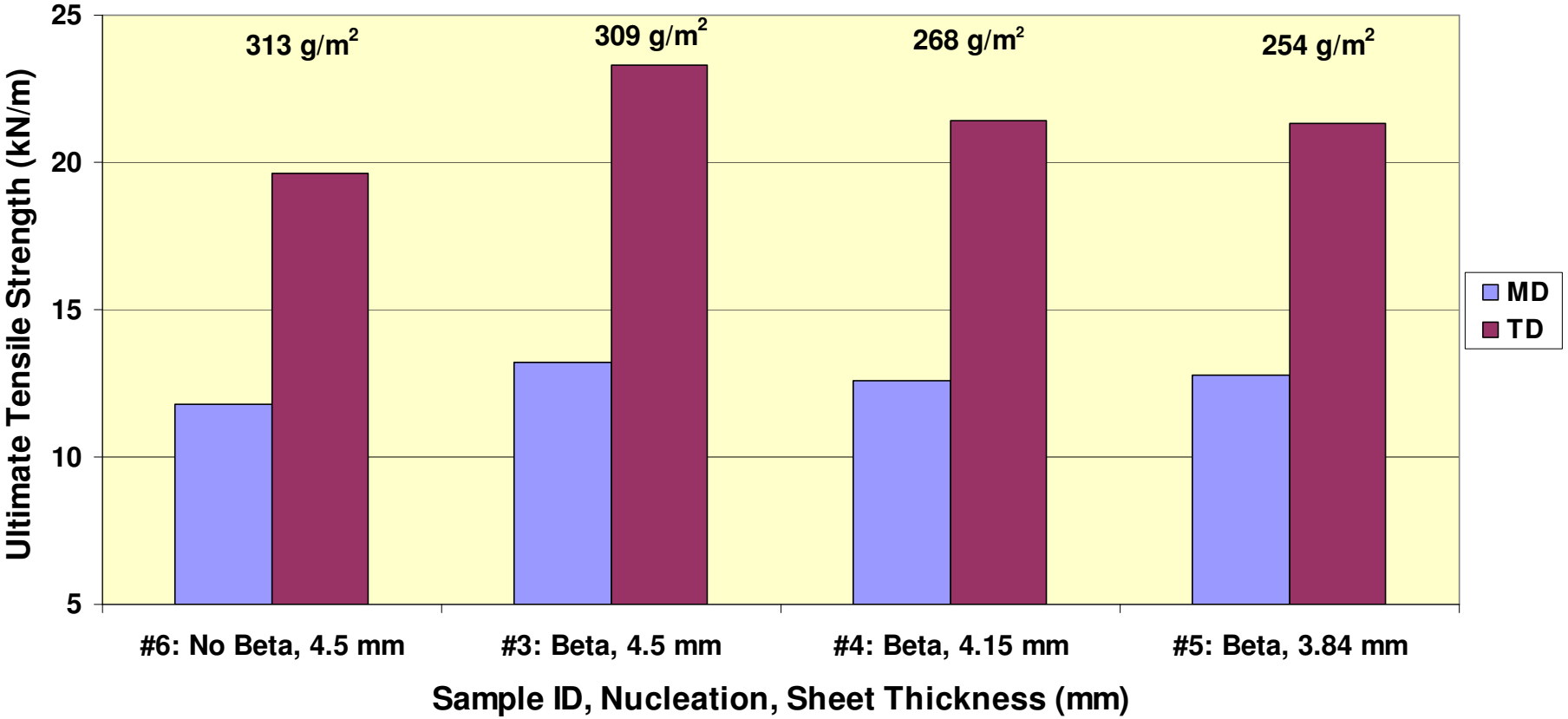
Tensile Strength of Geogrids Made With and Without Beta Nucleation

Sample ID, Nucleation, & Sheet Thickness	Mass (g/m^2)	2% Tensile Str. (kN/m)		5% Tensile Str. (kN/m)		Ultimate Tens. Str. (kN/m)	
		MD	TD	MD	TD	MD	TD
#6: No Beta, 4.5 mm	313	6.0	9.0	11.8	19.6	19.2	28.8
#3: Beta, 4.5 mm	309	7.9	13.0	13.2	23.3	24.3	36.4
#4: Beta, 4.15 mm	268	7.6	11.5	12.6	21.4	23.9	32.2
#5: Beta, 3.84 mm	254	7.6	11.6	12.8	21.3	23.4	31.0

Note:

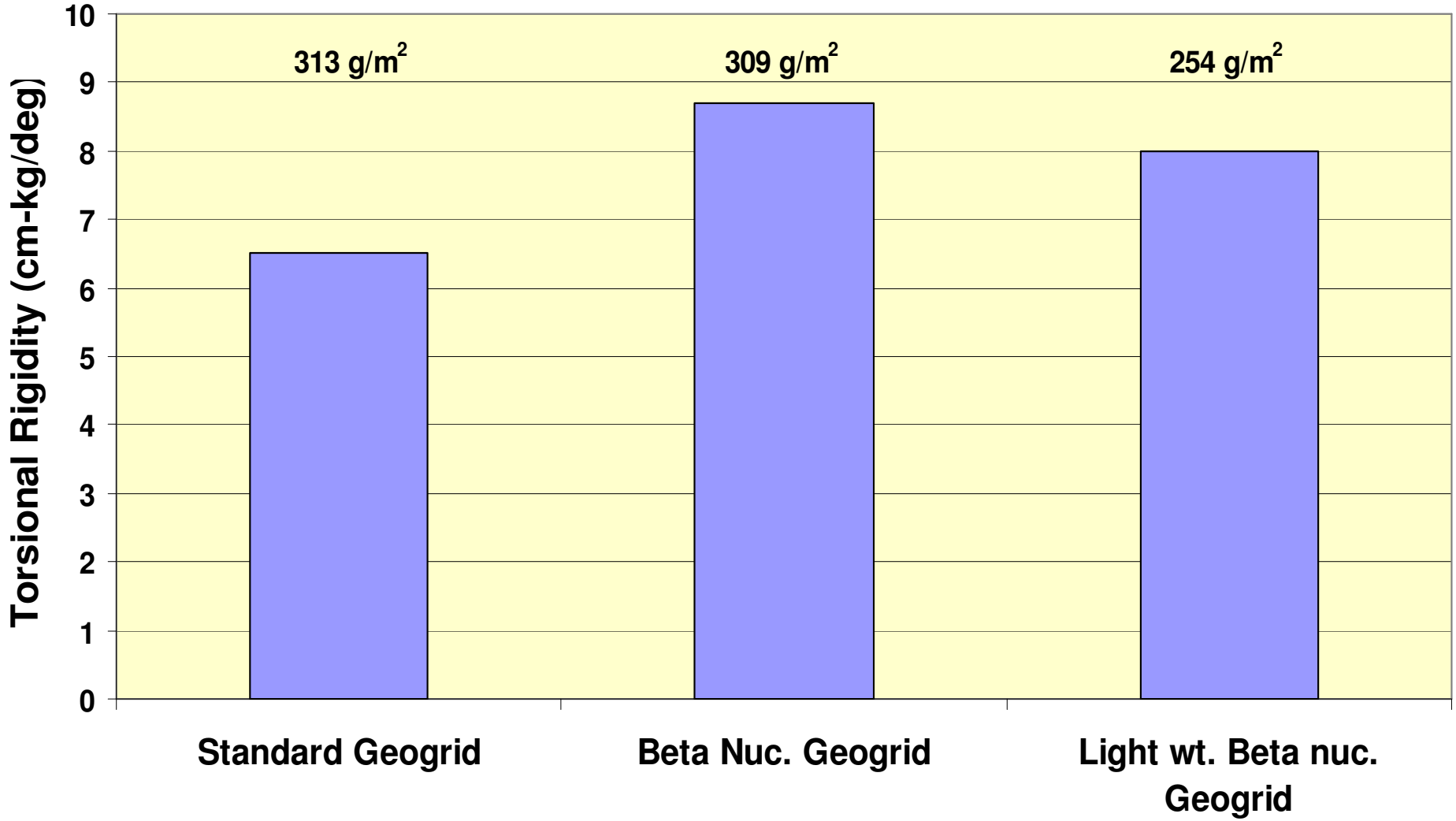
In comparing sample #6 (no beta) with sample #5 (beta), the mass (basis weight) of the geogrid decreased by 19%, while the Ultimate Tensile Strength increased by 22% in the MD, and 8% in the TD.

Ultimate Tensile Strength of PP Geogrids With and Without Beta Nucleation



Torsional Rigidity of Biaxial Geogrids

(Geogrid Basis Weight Shown Above Bars)



Effect of Mayzo Additive on Geogrid Processing and Product Appearance

- **More neck-in of grid after MDO step (5-10% width reduction)**
- **Flatter nodes after TDO step**
- **Wider node region after TDO step**
- **Wider ribs after TDO step**
- **Can be oriented at lower temperatures and at faster line speeds**

Benefits of Beta Nucleation for the Production of Geogrids

- More uniform orientation of the perforated sheet resulting in node regions that are thinner and wider, with more PP present in the "high strength" oriented strands
- Increased strength and rigidity of the final geogrid allows for a reduction in the weight and cost of the geogrid
- Higher throughput rates can be used during the transverse stretching step (50% increased productivity achieved during trials) resulting in higher productivity and reduced production costs
- The Mayzo masterbatch can be added at the extruder hopper to conventional PP resins to achieve the benefits of beta nucleation

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