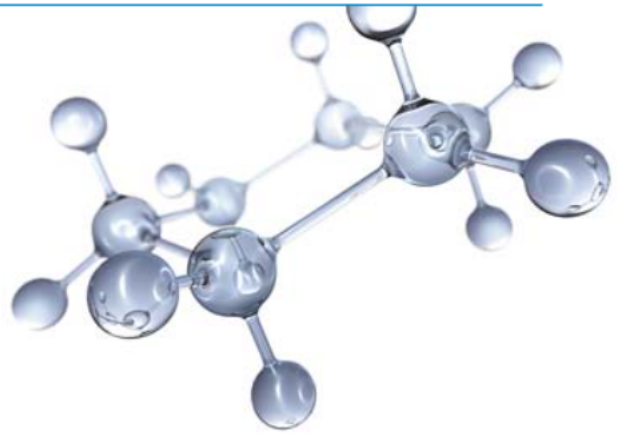
ExxonMobil Chemical

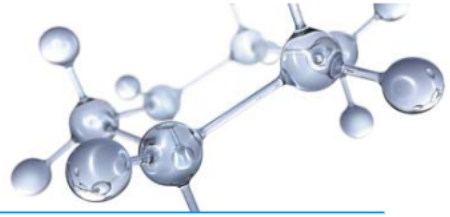
Vistamaxx™ propylene-based elastomer

an innovation for the masterbatch industry



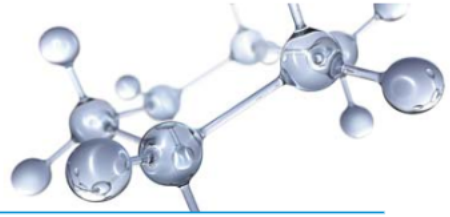
Vistamaxx™
propylene-based elastomers

Participation Guidelines



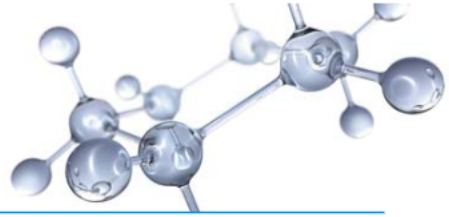
- Involvement in a symposium can benefit the participants but also carries potential competition law sensitivities due to the interaction among competitors
- It is ExxonMobil policy that all employees shall comply with the competition laws of all countries and we wish to remind all participants in this symposium that these laws apply to all of us
- Therefore, sensitive topics such as prices, production, inventory, sales, costs, future business plans, or matters relating to individual customers or other confidential or proprietary information should not be discussed
- Nothing in this material is intended to override the corporate separateness of local entities
- The terms corporation, company, affiliate, ExxonMobil, Exxon, Mobil, Esso, our, we and its, as used in this material may refer to Exxon Mobil Corporation, to one of its divisions, or to the companies affiliated with Exxon Mobil Corporation, or to any one or more of the foregoing - the abbreviations are used merely for convenience and simplicity

Agenda

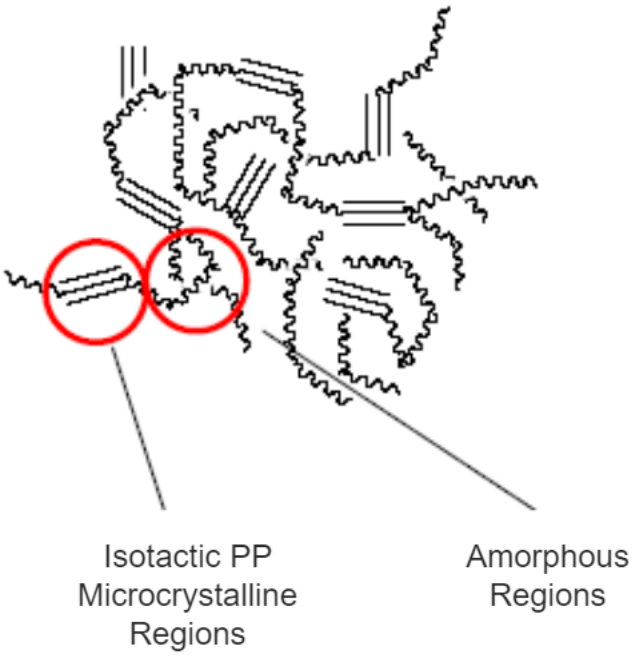


- Introduction
- Technical study of Vistamaxx™ propylene-based elastomer (PBE) benefits to compounders
  - Dispersion evaluation
  - Lower processing temperature
  - Higher loading capability
  - Compounding process improvement
- Vistamaxx PBE benefits to end-users
  - Polypropylene modification
  - Film
  - PP woven fabrics
- Conclusions

Vistamaxx™ propylene-based elastomers

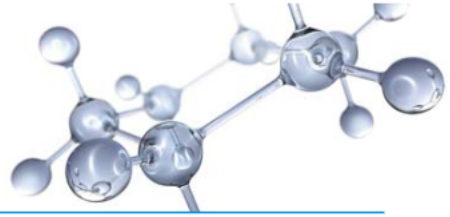


- Vistamaxx propylene-based elastomers are
  - Copolymers of propylene and ethylene
  - Propylene rich: >80%
  - Semi-crystalline: high amorphous content
  - Based on ExxonMobil Chemical's Exxpol™ technology
- Compatibility with other polyolefinic materials
- Vistamaxx propylene-based elastomer is the next generation of products building on ExxonMobil's history of providing technically advanced solutions to the market



Cutting edge technology and processing deliver new possibilities

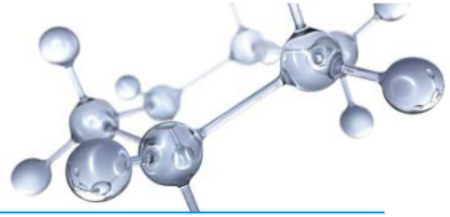
New possibilities in a range of applications

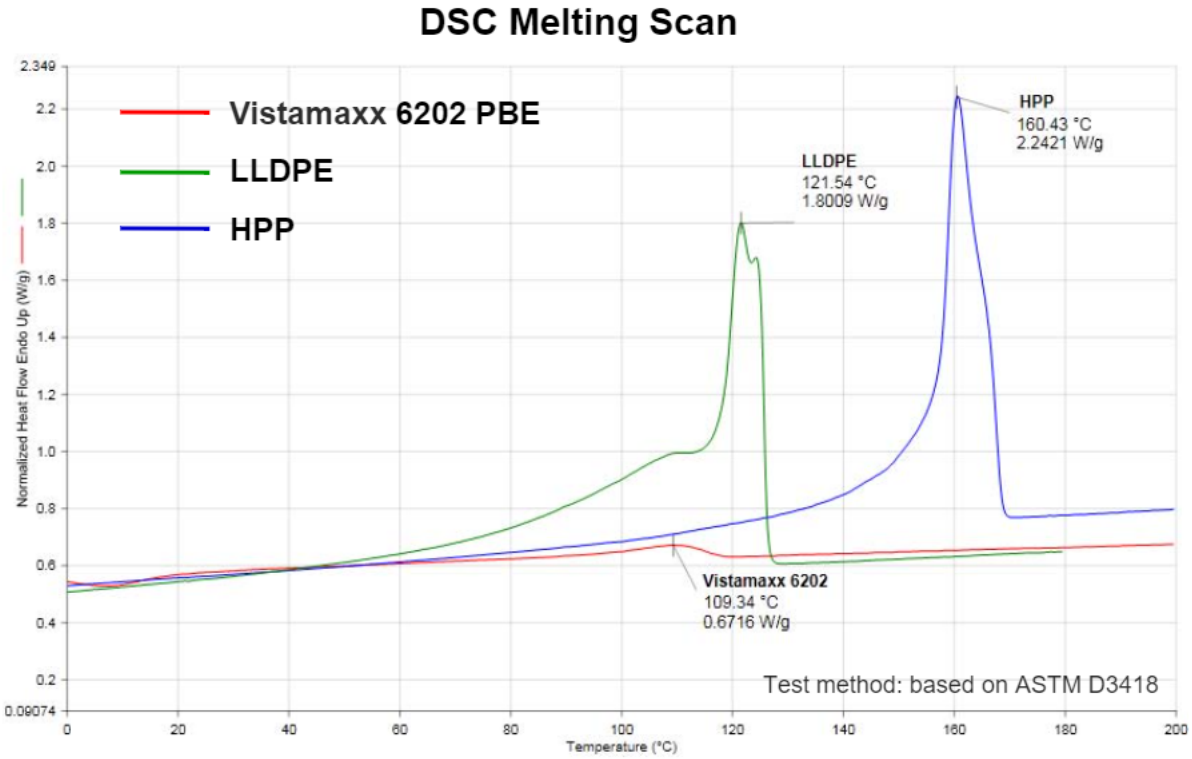


- Nonwovens
  - Elasticity, softness and toughness
  - Delivered with drop-in processing performance
- Films
  - Elasticity, sealability, toughness and tack
- Polymer Modification and Compounds
  - Impact strength, transparency, flexibility/stiffness, softness, high filler loading

New levels and unique combinations of properties add value broadly

Lower processing temperature

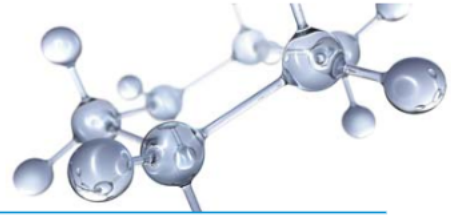




Low melt temperature of Vistamaxx™ 6202 propylene-based elastomer (PBE) allows lower mixing temperature during masterbatch compounding process

Protect heat sensitive additives in masterbatch compound

Vistamaxx™ propylene-based elastomers grade slate

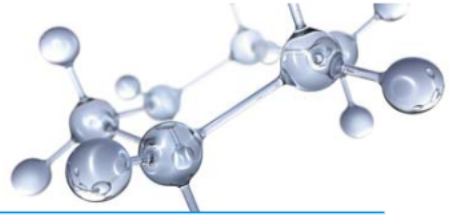


	Typical Values								
Grade	Ethylene Content, EM Method, %	MFR 230°C/2.16 kg EM Method g/10 min	Density ASTM D1505 g/cm^3	Hardness ASTM D2240 Shore A/D	Tensile Strength @ Break ASTM D638 MPa (psi)	Elongation @ Break ASTM D638 %	Flex Mod 1% Secant ASTM D790 MPa (psi)	Tear Strength Die C ASTM D624 kN/m (lbf/in)	Vicat Softening Point, EM Method °C (°F)
3000	11	8	0.873	33 D	17.1 (2480)	1898	59.3 (8610)	62.3 (356)	65.6 (150)
3020FL*	11	3	0.874	34 D	17.0 (2460)	1756	59.7 (8650)	64.3 (367)	68.3 (155)
3980FL*	9	8	0.878	40 D	17.2 (2500)	1682	110 (16000)	81.3 (464)	76.7 (170)
6102/ 6102FL*	16	3	0.862	66 A	>6.89 (>1000)	>2000	12.3 (1790)	34.3 (196)	52.2 (126)
6202/ 6202FL*	15	20	0.863	66 A	>5.50 (>798)	>2000	12.3 (1790)	33.3 (190)	47.2 (117)

*The “FL” designates this product passes ExxonMobil Chemical’s test for film appearance with regard to gels, as needed for performance film applications (‘A’ rating).

Vistamaxx propylene-based elastomer grades are used in the nonwoven, film, polymer modification and compounding markets

Benefits

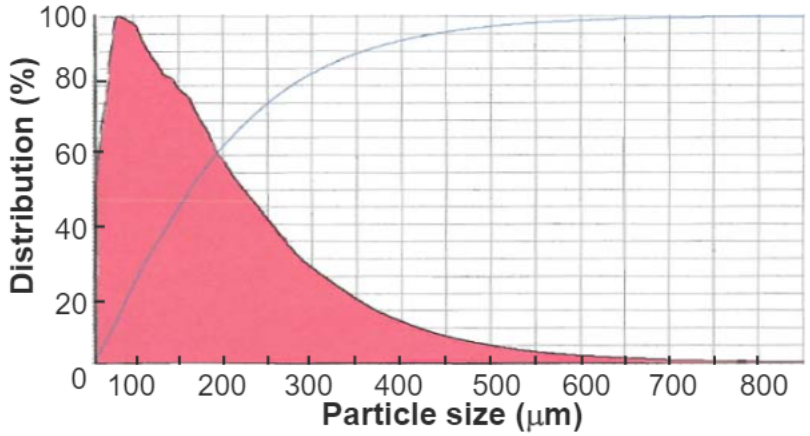


Delivered features	Derived benefits	Importance to you
• Unique product morphology using ExxonMobil proprietary technology	• Excellent heat stability and less polymer degradation or formation of cross-linked gels vs. LLDPE and hPP • Narrow molecular weight distribution • Transparent pellets • Lower density vs. PE/PP and higher filler acceptance	• Broad processing window in various types of compounding machines • Better dispersion and wetability of pigments and fillers vs. LLDPE and hPP • Easy color matching with various pigments • More finished parts per kg resin and lower MB cost due to use of inexpensive fillers vs. LLDPE and hPP
• Low melt temperature	• Potential energy saving by compounding at lower temperature and shorter cycle time	• Potential for energy cost savings and less thermal degradation of polymer carrier • Excellent carrier for heat sensitive additives such as blowing agents or flame retardants
• Compatible with BOTH polyethylene (PE) and polypropylene (PP)	• Universal carrier for both PE or PP based MB allows consolidation of grade mix offered to end customers	• Reduced number of grades and better inventory control may allow better cash flow and less product wastage
• Inert polymer with no odor and broad compliance to US, European and Japanese food laws	• Less corrosive to compounding equipment vs. Ethylene-Vinyl Acetate (EVA) • Food contact applications	• May lower equipment maintenance cost • Meet increasing end-user demand for food law compliance and certification

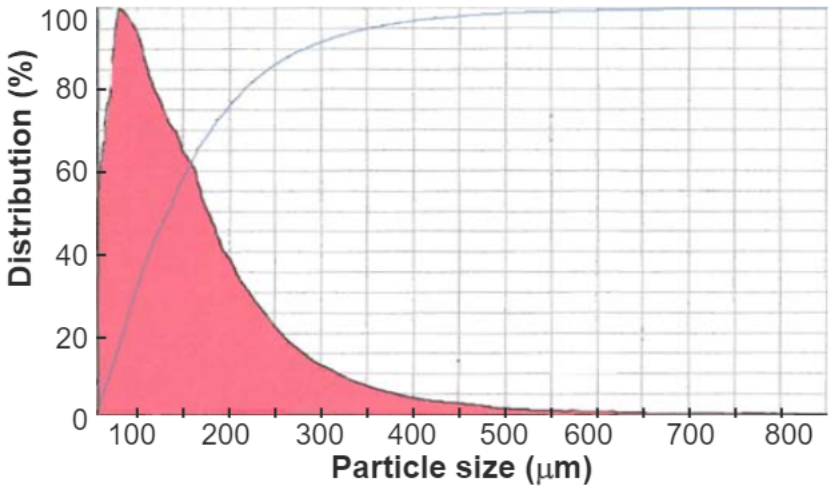
Carbon black dispersion evaluation

- Carbon black disperses better in Vistamaxx™ 6202 propylene-based elastomer (PBE) than either LLDPE or hPP

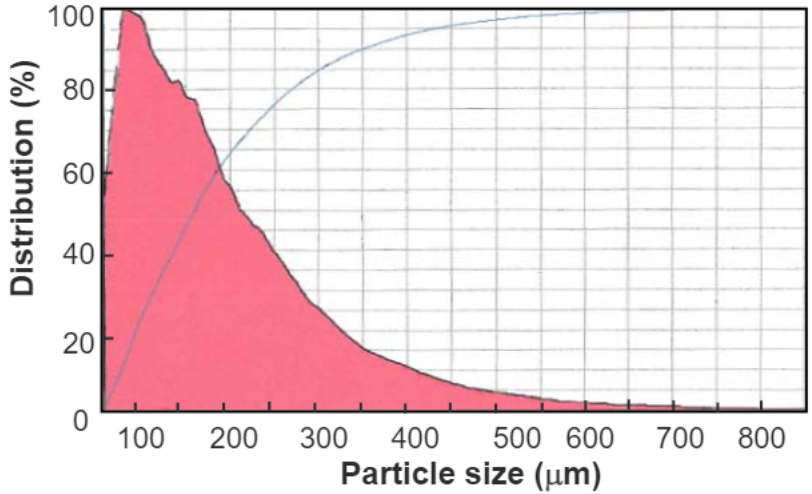
Particle size distribution – hPP as carrier



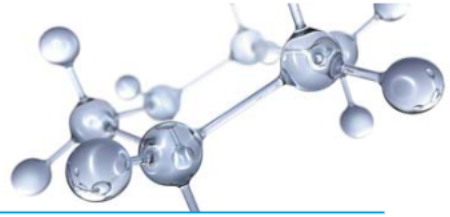
Particle size distribution – Vistamaxx PBE as carrier



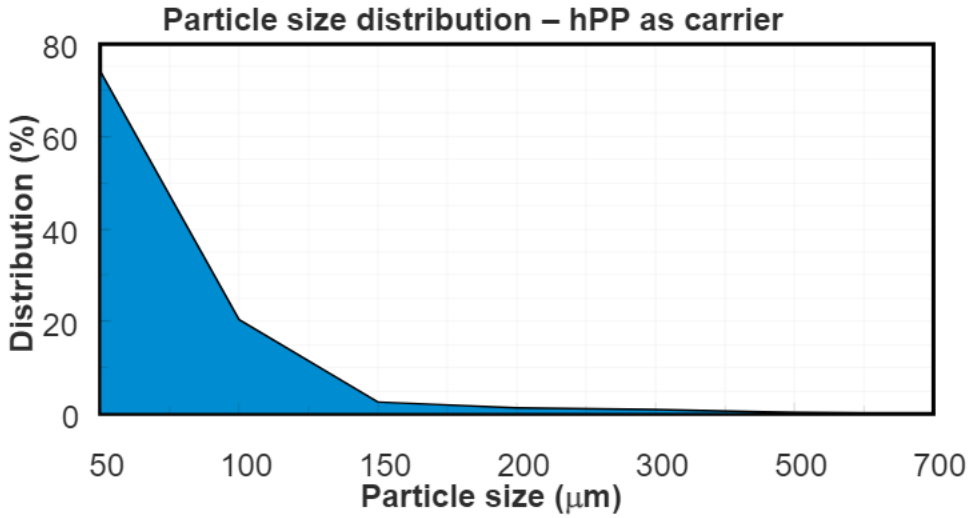
Particle size distribution – LLDPE as carrier

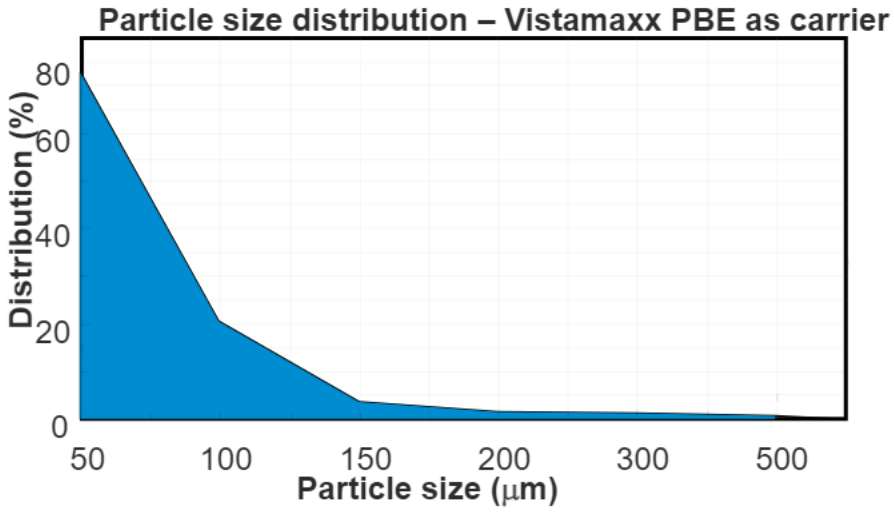


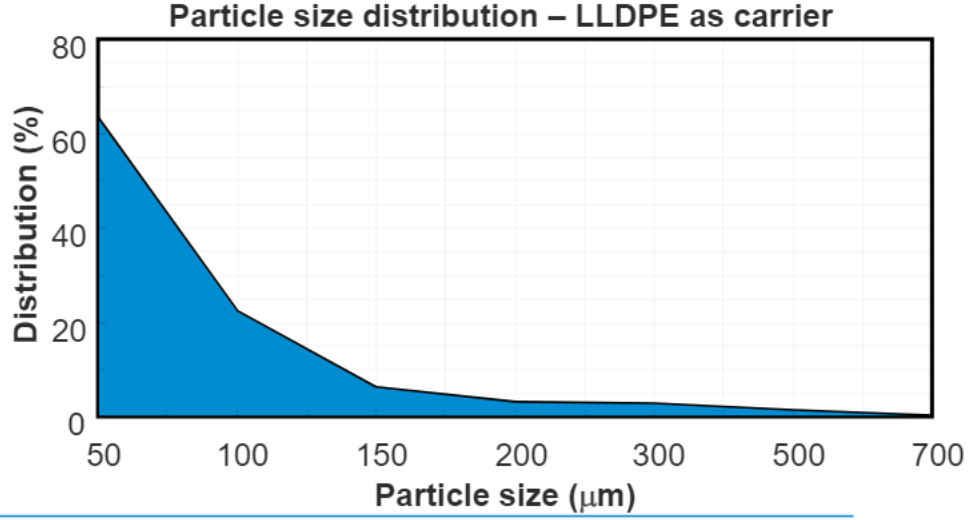
$CaCO_3$ dispersion evaluation



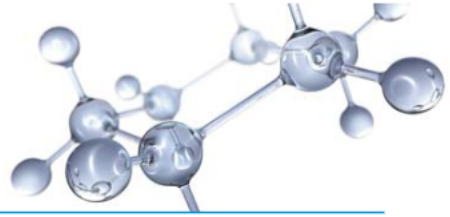
- $CaCO_3$ disperses better in Vistamaxx™ 6202 propylene-based elastomer (PBE) than LLDPE
- $CaCO_3$ dispersion in hPP is comparable to Vistamaxx PBE



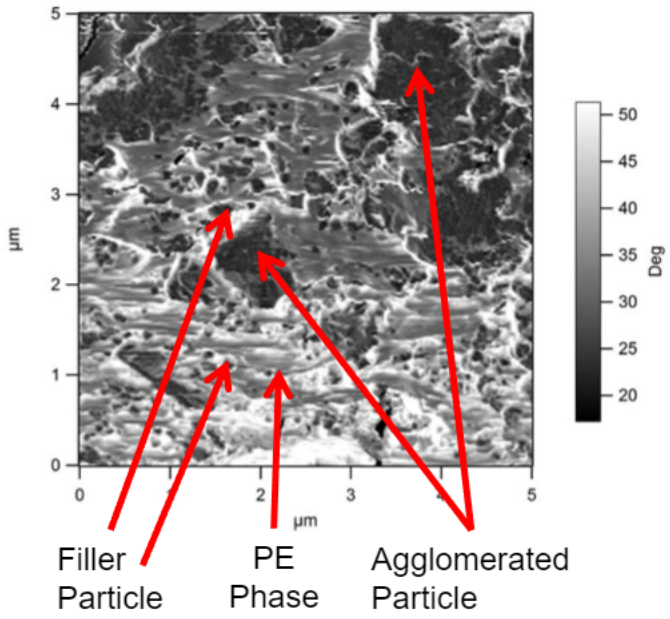




Atomic force microscopy study of filler dispersion

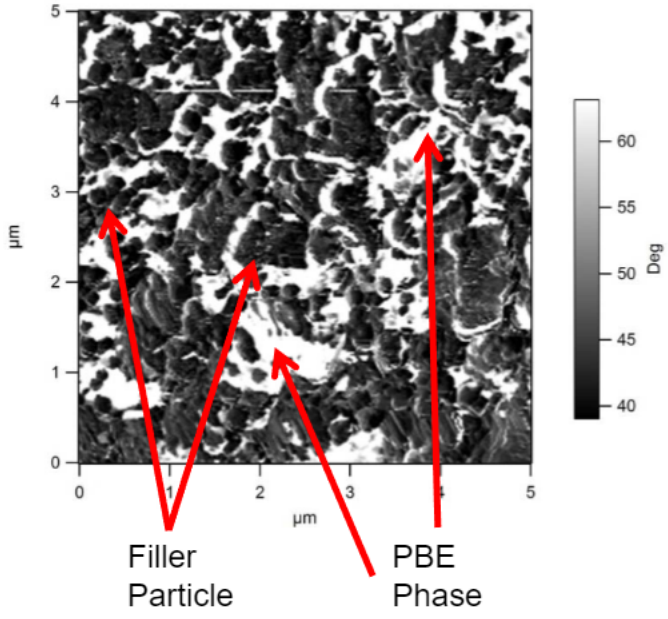


LLDPE Masterbatch



70% filler

Vistamaxx PBE based Masterbatch



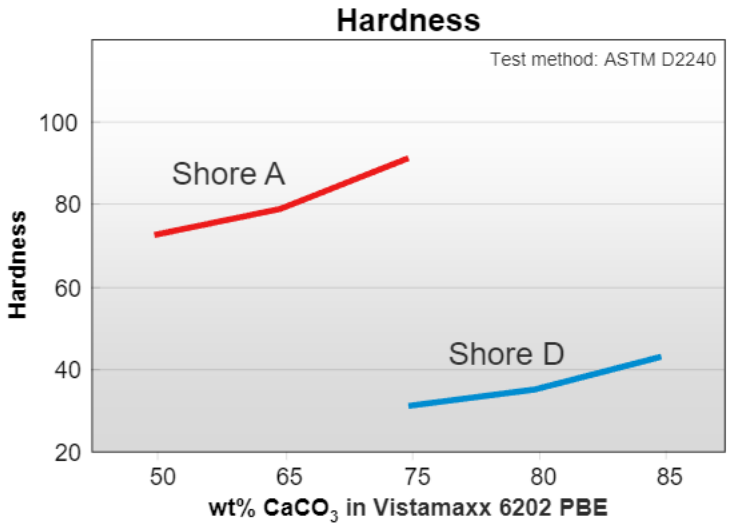
80% filler

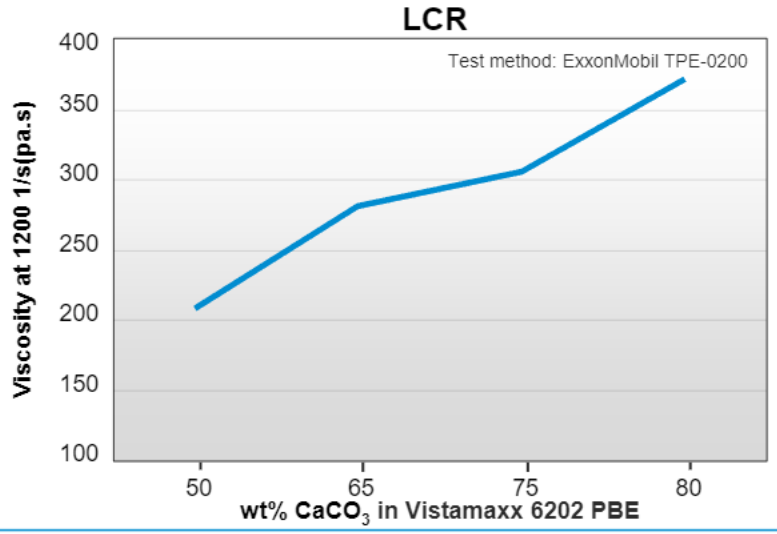
Note: Calcium carbonate raw material mean particle size < 1 µm

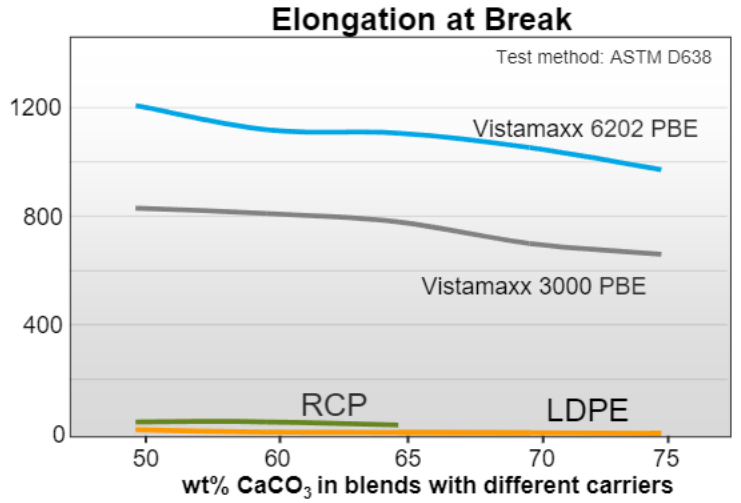
- Individual filler particles and agglomerates are clearly visible in both samples and easily distinguished from polymer phase
- Filler dispersion is more uniform in Vistamaxx™ propylene-based elastomer (PBE) carrier than in LLDPE carrier

High filler loading capability

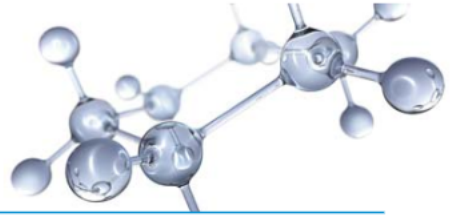
- Up to 85% by weight $CaCO_3$ can be loaded into Vistamaxx™ propylene-based elastomer (PBE)



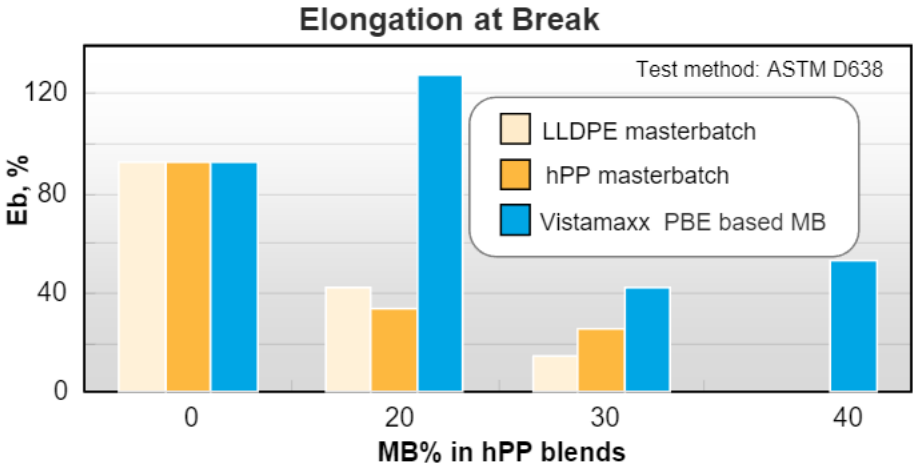


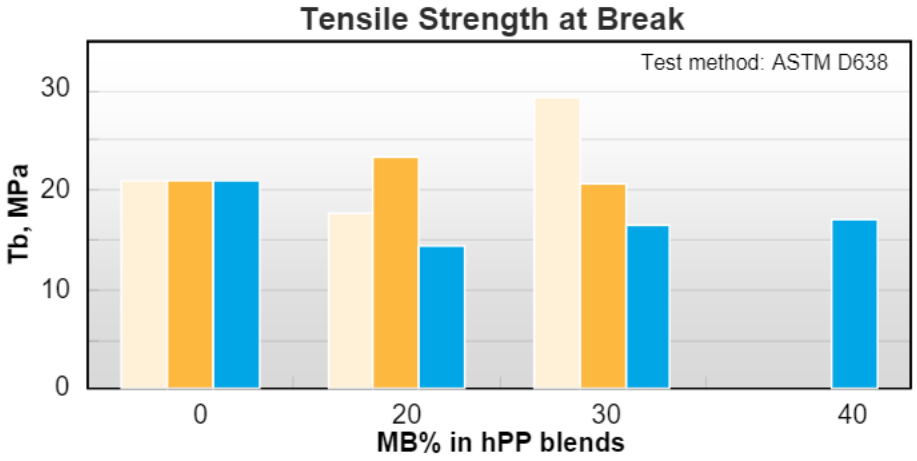


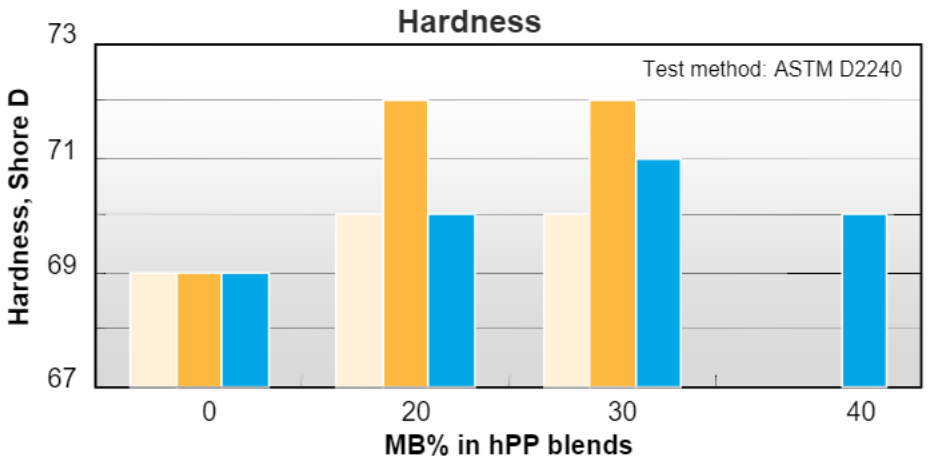
Load more MB into hPP



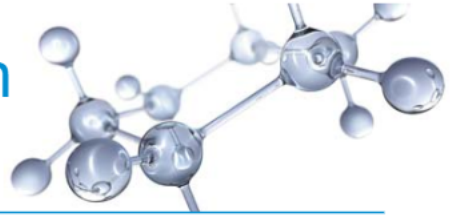
- Up to 40% Vistamaxx™ propylene-based elastomer (PBE) based MB can be loaded into hPP without sacrificing mechanical integrity



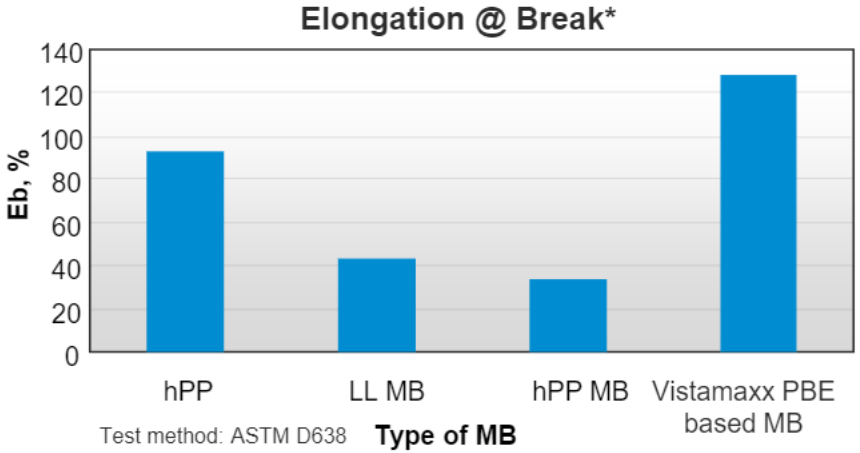


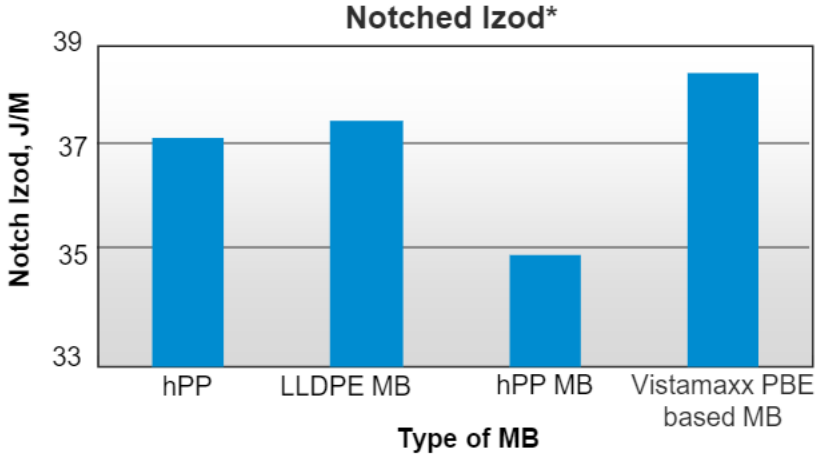


Use a Vistamaxx™ PBE based masterbatch to enhance product properties

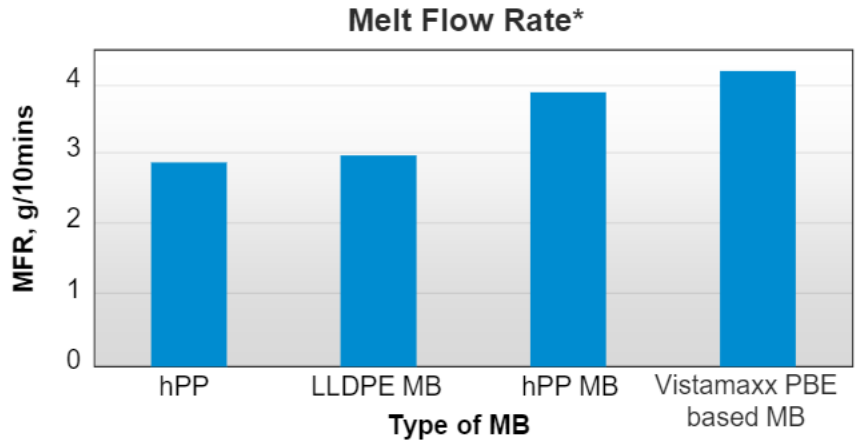


- Vistamaxx™ propylene-based elastomer (PBE) for:
  - Better elongation for increased flexibility
  - Higher impact strength
  - Higher MFR for easy processing





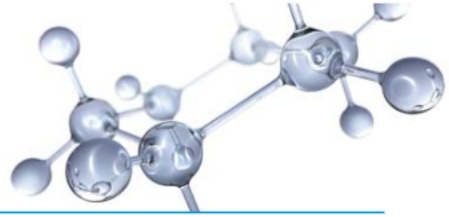
Test method: ASTM D256 Method A



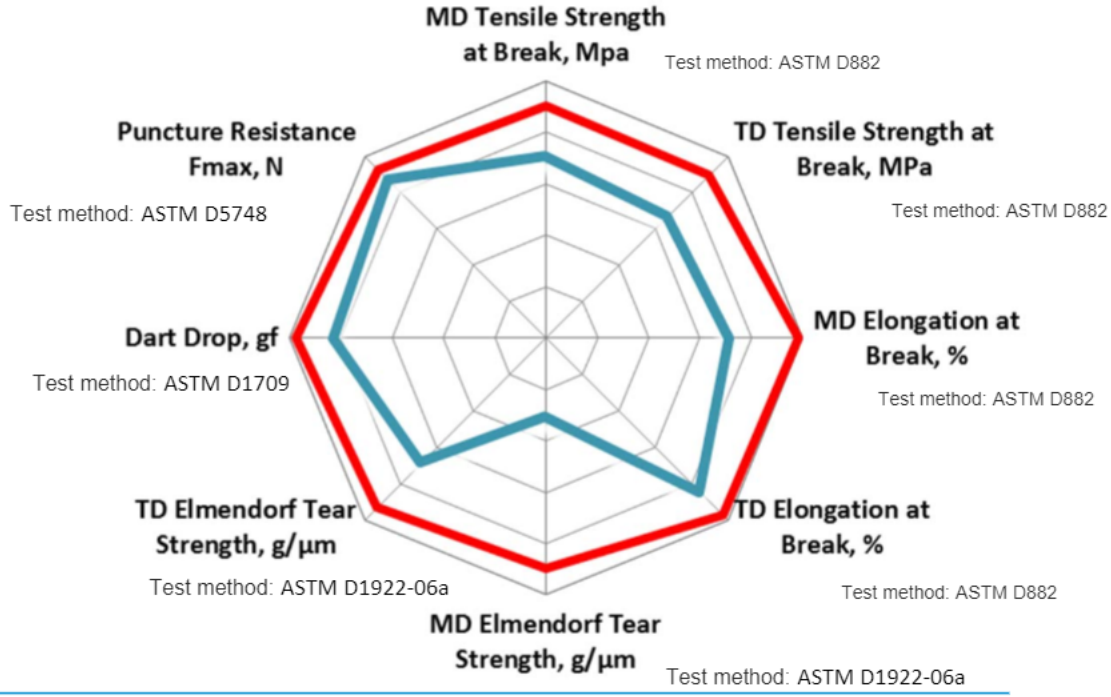
Test method: ISO1133 Method B

* 100% hPP vs. 80/20 blends with various masterbatches

End-use performance study – blown film



- Vistamaxx™ propylene-based elastomer (PBE) creates lower cost and higher performing solutions through better mechanical properties
- Adding Vistamaxx PBE provides more balanced mechanical properties especially on MD tear strength and elongation at break



Note: MD = machine direction; TD = transverse direction

Benefits to your end users

Vistamaxx™ PBE based masterbatch vs. LLDPE/LDPE/hPP based masterbatch

PP Injection Molding applications

- Better elongation and impact strength deliver less part breakage during end use applications vs. PE/PP masterbatch (MB).
- Higher productivity/shorter cooling time vs. PE/PP MB due to higher thermal conductivity of the $CaCo_3$ filler MB
- More MB can be let-down for cost reduction with minimal Impact on mechanical properties.

HDPE shoppers and garbage bags

- Improve key film properties such as tear/impact strength and puncture resistance
- HDPE/filler MB/recycle blend ratio with excellent balance in strength-toughness allows potential for further cost reduction.
- Film downgauging possibility

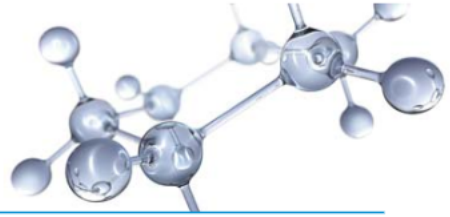
PP woven fabric

- Higher yarn tenacity with increased stretch ratio to achieve tougher yarn vs. traditional AFMB
- Higher AFMB let-down ratio for cost reduction vs. traditional AFMB
- Less water carry-over, dusting and yarn breakage during manufacturing process vs. traditional MB.

PP spun bond non-woven applications

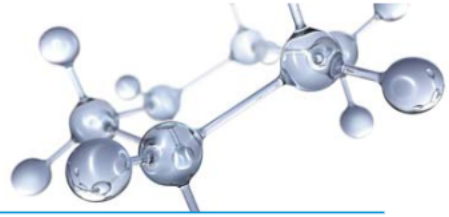
- Easy draw down to achieve thin fiber diameter with high tensile strength due to narrow Vistamaxx PBE MWD
- Raw material cost reduction through higher let-down ratio of Vistamaxx PBE MB vs. PE/PP MB
- Softer fiber with balanced MD/TD mechanical properties with fabric downgauging potential vs. PE/PP MB
- Reduced fiber breakage at high spinning speed vs. traditional PP based filler MB

HDPE shoppers and garbage bags

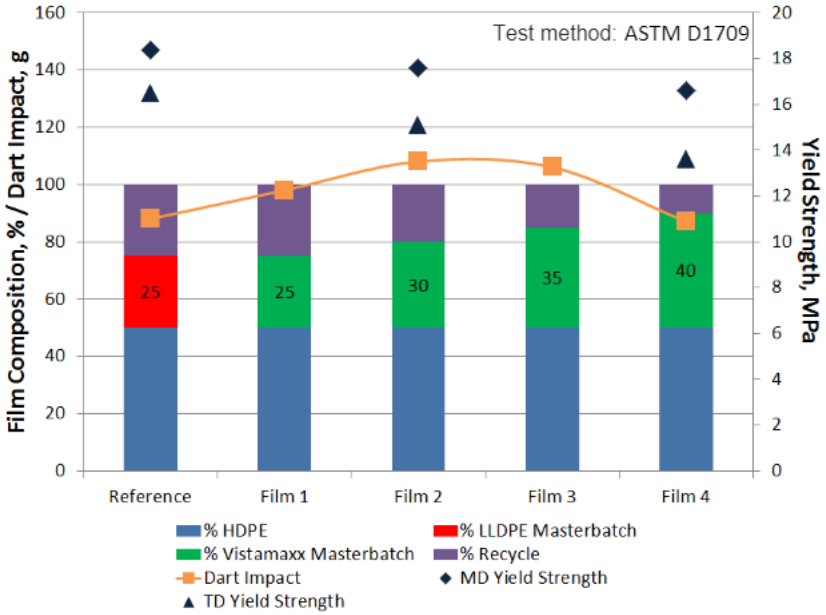


- Trends
  - Cost reduction, flat demand
  - Increase in filler and recycle material
  - Limited down gauging option
  - New legislations on the usage of plastic carry bags
- Drivers
  - Lower margins, stiff competition
  - Ban on plastics bags in some states / countries

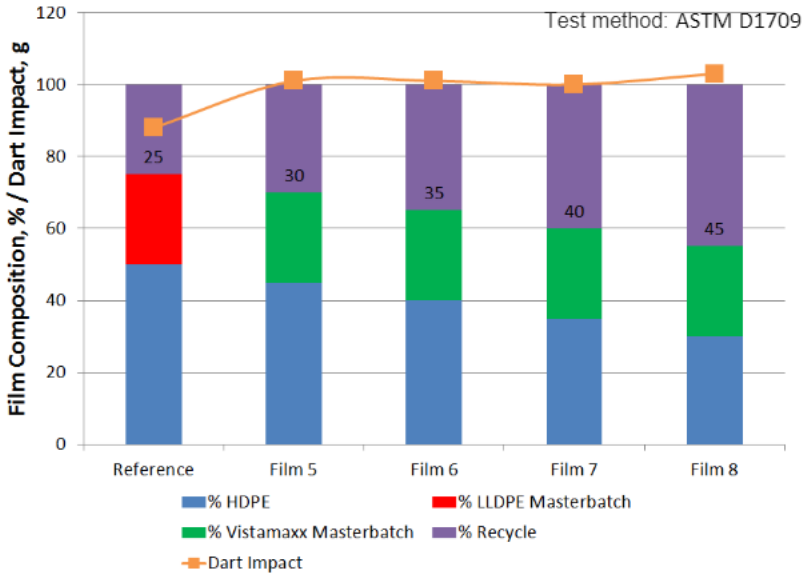
Replace current $CaCO_3$ MB for higher filler loading or increased recycle



Increase $CaCO_3$ Content



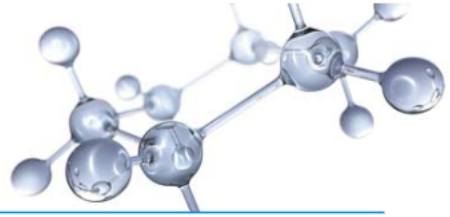
Increase Recycle Content



ExxonMobil Data
Films produced on commercial line
20μm nominal thickness
All masterbatches used contain 80% $CaCO_3$

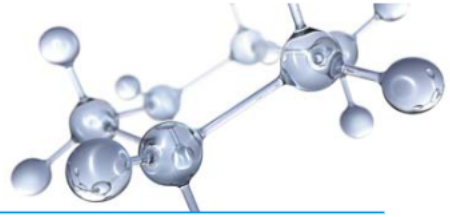
Vistamaxx™ propylene-based elastomer (PBE) based masterbatch provides a technical path to enhance the property profile at a lower solution cost

Value proposition



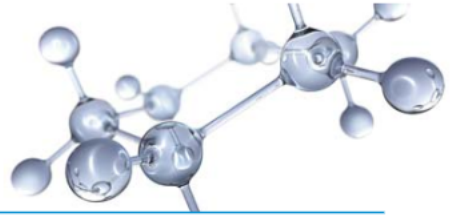
- Addition of Vistamaxx™ propylene-based elastomer (PBE) to the crystalline iso-tactic homopolymer PP (hPP) base of the raffia makes it softer and introduces flexibility and elasticity
- Vistamaxx PBE improves elongation in HPP blends
  - Tapes then can be stretched more in hot air oven thus inducing more orientation
  - More orientation results in higher tenacity
  - With higher tenacity customer may downgauge the denier and make lighter fabric with same (reference) tenacity
- Applications where customers do not want to downgauge (sell fabric on kg base)
  - They can add higher levels of AFMB, thus maintaining the tenacity but increasing the weight of the bag through filler
- Other benefits VS. hPP based AFMB
  - Improved burst strength
  - Stackability because of higher COF
  - UV stability better than hPP

Additional advantages of tougher / softer yarn

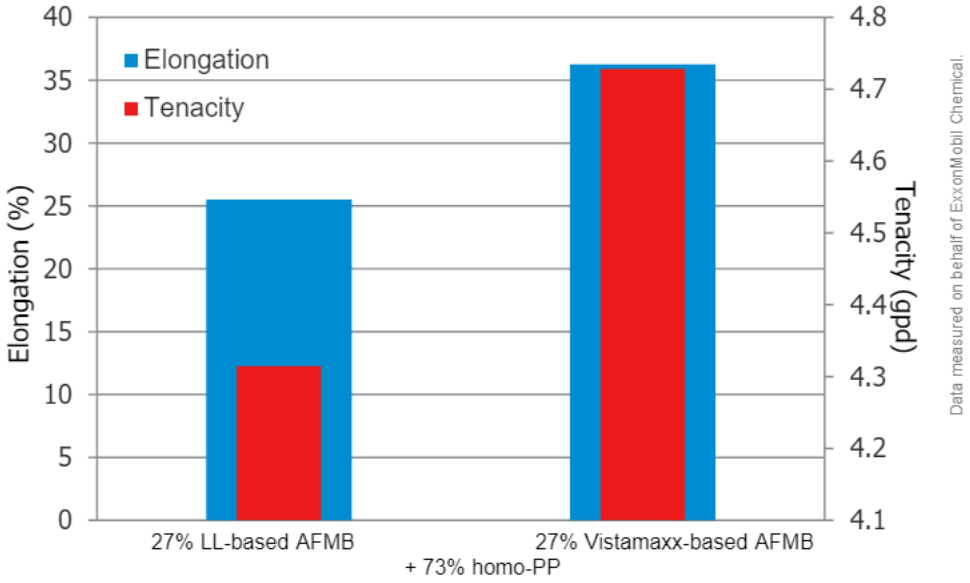


- Bags made from the fabric resulting from the Vistamaxx™ propylene-based elastomer (PBE) modified yarn will have better stackability
- The softer, more elastic fabric will provide improved bag drop resistance for 25 to 50kg bags
- The fabric made, resulting from Vistamaxx PBE modified hPP, will benefit from the better UV resistance of Vistamaxx PBE, providing extended exposure to outdoor weathering
- On average, PP raffia producers have 6 to 8% waste
    - Fabric loses properties if reground to granules
    - Some customers use a small percentage of regrind for non critical application fabric
    - Vistamaxx PBE facilitates use of the regrind in following way
        - Improves elongation
        - Reduces tape break
        - Some customers can use up to 30% regrind for non critical applications

Vistamaxx™ 6202 PBE –based AFMB



Replacing LL-based AFMB by AFMB based on Vistamaxx 6202 propylene-based elastomer (PBE), under the same process conditions, provides more strength and elongation



Materials used:

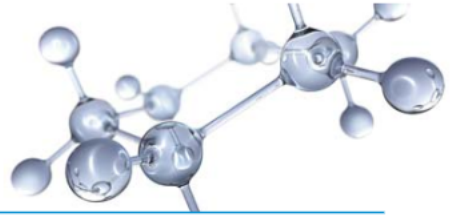
Property	C4-LLDPE	Vistamaxx 6202	hPP
Density, g/cm^3	0.918	0.861	0.9
MFR, dg/min	20	18	2.8

Conditions used:

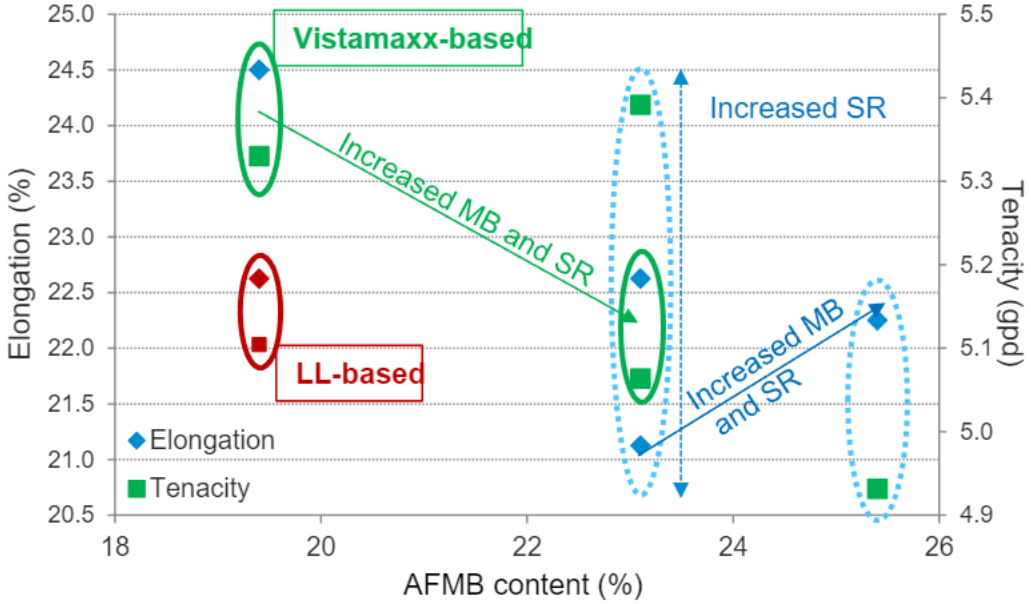
	Reference	Vistamaxx PBE based
Tape width (mm)	2.77	2.72
Tape weight (denier)	591	579
Stretch ratio (%)	4.49	4.47

- Vistamaxx 6202 PBE as carrier for $CaCO_3$ MB allows better dispersion of the mineral in the base material as well as better dispersion of the MB in the homo-PP matrix of the raffia tapes
- At equally high content of AFMB, Vistamaxx PBE base MB provides a significant increase in both elongation at tenacity

Vistamaxx™ 6202 PBE based AFMB



Replacing LL-based AFMB by AFMB based on Vistamaxx 6202 propylene-based elastomer (PBE) allows higher filler dosage at similar tape properties.



Data measured on behalf of ExxonMobil Chemical.

Materials used:

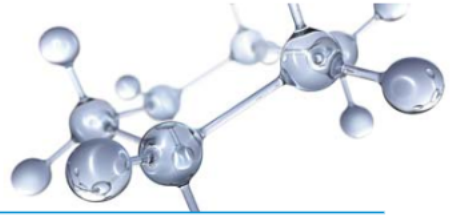
Property	C4-LLDPE	Vistamaxx 6202	hPP
Density, g/cm^3	0.918 / 0.926	0.861	0.9
MFR, dg/min	0.9 / 50	18	2.8

Conditions used:

	Reference	Vistamaxx based			
Tape width (mm)	2.45	2.45	2.49	2.58	2.62
Tape weight (denier)	862	863	864	830	877
Stretch ratio (%)	6.87	6.87	7.08	7.49	7.75

- Simple replacement of AFMB provides again improvement in elongation and tenacity
- Higher dosage while increasing stretch ratio yields tapes with similar properties as reference
- Higher SR ratio will provide better tenacity at the cost of elongation, or further increase in AFMB level while increasing SR will yield tapes with similar elongation at the slight cost of tenacity

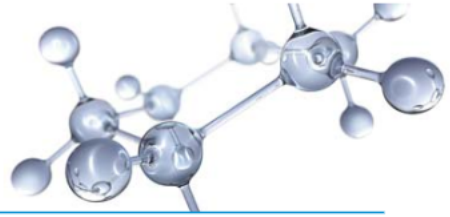
Delivered attributes and value



Vistamaxx™ PBE based AFMB vs. hPP based AFMB

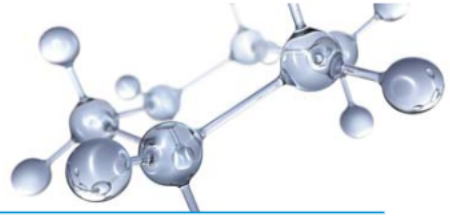
Delivered attributes	Derived benefits and potential value
Softer film and tapes	• More stretch, thus more orientation • Improved tenacity • Cost reduction opportunities by reducing the denier for same strength • Less tape breakage • Increased specific output • More stretch at lower temperature, thus less energy consumption
More loading of AFMB (based on Vistamaxx propylene-based elastomer [PBE])	• Maintains elongation and tensile • Less dust accumulation near looms • Cost reduction opportunities by blending more AFMB
Higher COF of the film	• Less water carrying

Summary



- Vistamaxx™ propylene-based elastomer (PBE) as carrier polymer for masterbatch offers improved compound processing and performance relative to current alternatives
- PP product manufacturers can enjoy up to 40% use Vistamaxx PBE based filler masterbatch loading without sacrificing mechanical integrity
- HDPE shopper & garbage bag film producers can further optimize cost and performance by using Vistamaxx PBE as carrier
- PP raffia tape film producers can use Vistamaxx PBE based filler masterbatch to improve the properties of the tape, beyond acting as simple filler carrier

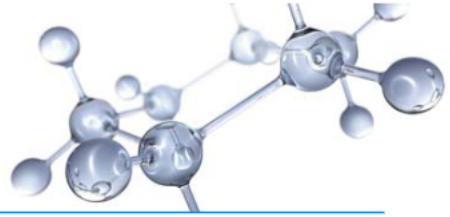
Conclusions



- Looking for:
  - Lower cost and higher performing solutions
  - Better dispersion of difficult organic pigment additives
  - Higher filler loading by compounders and MB let-down ratio by fabricators
  - Lower melt compounding temperatures
- Beneficial to:
  - Polypropylene modification
  - Film with improved mechanical properties
  - PP woven fabric
  - Nonwoven spun bond fabric

Vistamaxx™ propylene-based elastomer expands your possibilities in filled and color MBs!

Disclaimer



May 2010