Next Gen. Mineral Solutions for Automotive Application PP & TPO's

Maz Bolourchi – Technical Director, Polymers

IMERYS

Agenda

- Brief IMERYS Intro
- Minerals in Plastics & Sustainability
- Automotive Mkt / OEM & Drivers
- New Suzorite™ Apex Mica for:
  - Maximum Reinforcement & Dimensional Stability
- Developmental Wollastonite for:
  - Translucency & Stiffness / Impact Balance
- ImerShield for Flame Retardancy
- Conclusions

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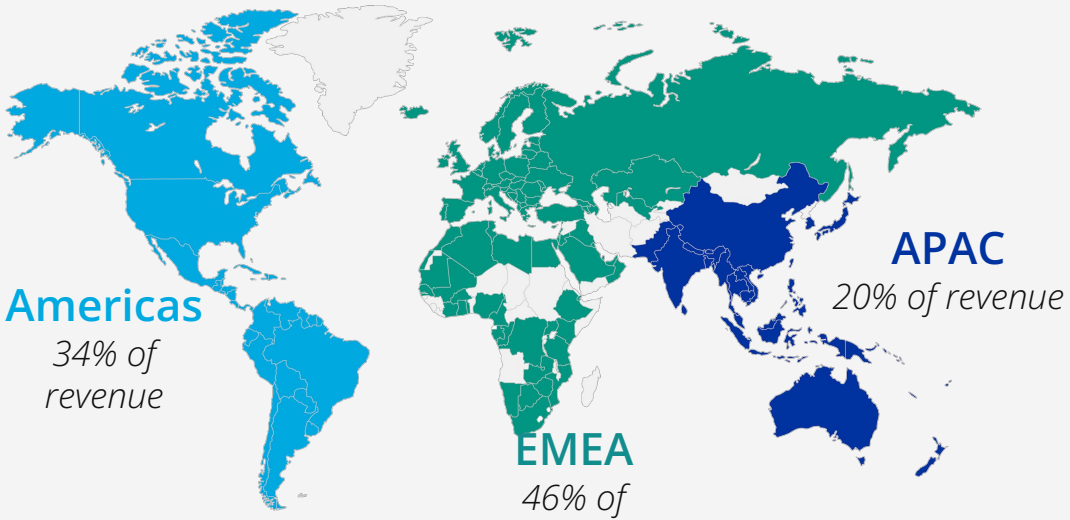
Imerys, a Global Industrial Minerals Provider

Imerys Mines/Processes over 30 different minerals with >100 mineral deposits worldwide adding value to our customers end-use applications



25,000 *customers*

€3.6bn *revenue*

Operations *in 33 countries*

Sales *In 126 countries*

12,400 *employees*

#1 in 75% *of our businesses*

**2024 figures*

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Imerys Commitment to Sustainability

Empowering our People

By reinforcing the maturity of our core values

We are introducing a new **Diversity, Equity & Inclusion** (DEI) index with the objective to achieve it at **100%** by **2025**.

We will improve our **Safety Culture Maturity** to **3.3**.

Growing with our Customers

By ensuring ethical business and accelerating the development of sustainable solutions

We will **assess 75% of our product** portfolio (by revenue) against **sustainability criteria by 2025**.

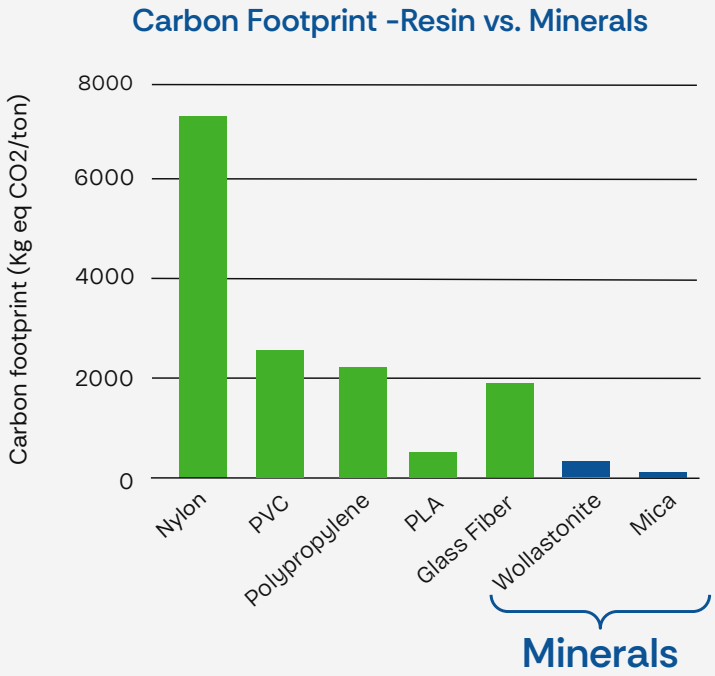
We will rate the sustainability practices of 75% of our **suppliers**

Caring for our Planet

by strengthening our commitments to preserve the environment

We will **reduce** the Group's **GHG emissions by 42% by 2030**, aligning on the **1.5°C trajectory**.

We are reinforcing our environmental stewardship with **4 new objectives**.



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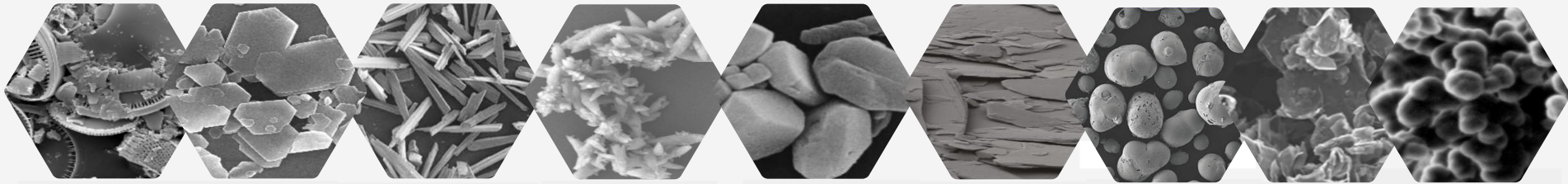
Value Added Functional Mineral Supplier



Diatomite | Kaolin | Wollastonite | PCC | GCC | Mica | Perlite | Graphite | Carbon Black

All our Mineral based Technologies provide a different balance of properties

Selection depends on Critical to Quality (CTQ's),

- REINFORCEMENT
- IMPROVED PROCESSING
- FLAME RETARDANCY
- SURFACE FINISH & COLOR
- RHEOLOGY MODIFIER
- DIMENSIONAL STABILITY
- ELECTRICAL CONDUCTIVITY
- THERMAL CONDUCTIVITY

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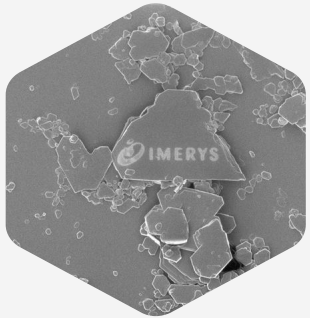
Tailored Solutions from Mine to Market

Fully Integrated process from ore mining & mineral processing to application development

Our Minerals are Engineered through processes that influence purity, size, morphology and surface chemistry to obtain the properties required for customer-specific applications.

MINING AND MINERAL PROCESSING EXPERTISE

ANALYTICAL EXPERTISE



PROCESSING AND APPLICATION EXPERTISE

TAILORED SOLUTIONS FOR AUTOMOTIVE COMPONENTS

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Automotive Sustainability Ambitions

OEM Ambition	How Minerals Can Support
Carbon Neutral Manufacturing	Carbon Footprint & Life Cycle Assessments
Vehicle Carbon Emission Reduction	Lightweighting
Circularity & Waste Reduction	Recycled Content
Responsible Materials	Transparent Supply Chain

Revolutionizing the Future with Minerals

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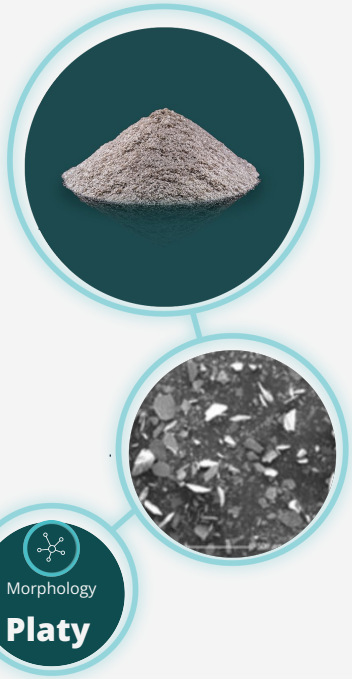
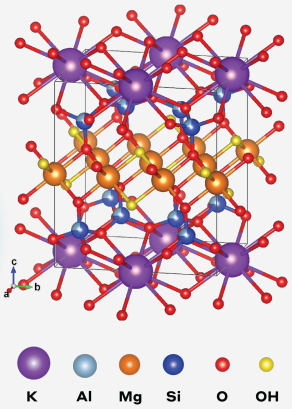
Mica Properties and Structure



$(Si_6Al_2)Mg_6O_{20}(OH)_4, K_2$



Phlogopite (Mg base)

Muscovite (Al content)

Mineral structure
Semi-rigid platelets that retain flexibility

Physical Properties and benefits to applications
High Thermal Stability
Low electrical conductivity

Production process
Crushing, Beneficiation/Separation, Grinding, Screening, Jet-Milling

Key analytical properties

	Muscovite	Phlogopite
Chemical Formula	$KAl_2(Si_3Al)O_{10}(OH)_2$	$KMg_3(Si_3Al)O_{10}(OH)_2$
Thermal stability (°C)	>600	>1000
Specific Gravity	2.8	2.7
Refractive Index	1.6	1.6
Loss at 1,000°C (%)	4.2	< 1.0
Hardness (Moh's)	2.5	3.0
pH value	7 - 9	~9
Aspect Ratio	50-100+	50-100+
Dielectric Constant	10	7

Imerys site origin
PMA: Boucherville Canada, Kings Mountain, NC

Main applications
Plastics (Mechanical reinforcement, Dimensional Stability, Thermal & Electrical Insulation), Rubber (Insulation),

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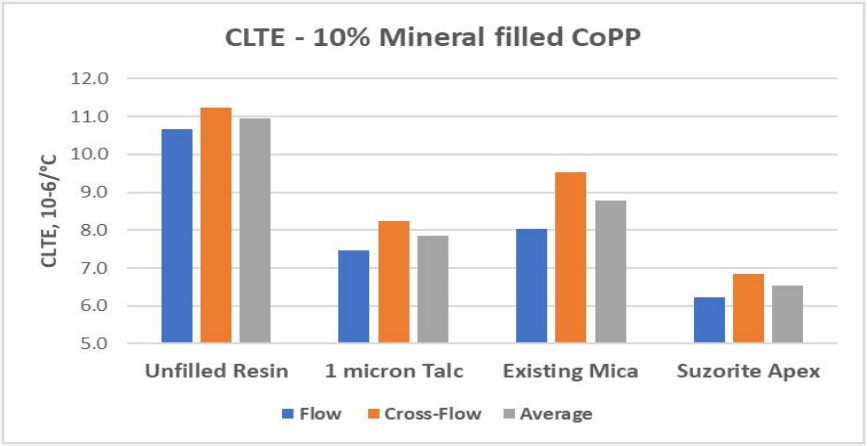
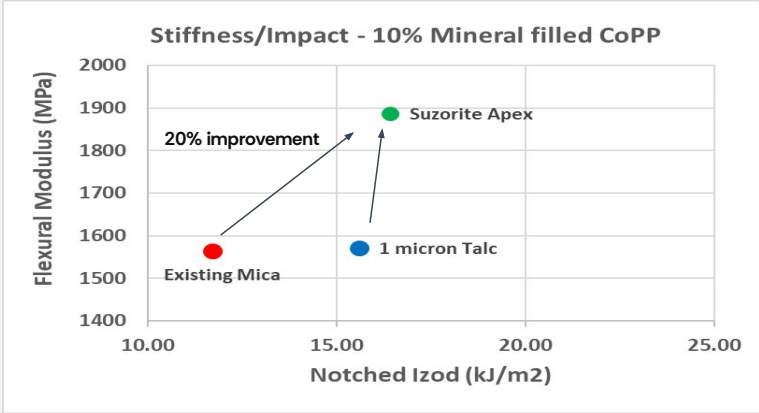
New Suzorite™ Apex

- What is it? & How can it help the Automotive Industry
- Next iteration of speciality Mica, a high purity, high aspect ratio w/ improved particle size distribution from Boucherville, Quebec. Canada
- New Suzorite™ Apex, HAR based Mica enables superior reinforcing & dimensional/thermal stability characteristics compared to incumbent Mica, specialty talc including submicron/ultrafine and HAR Talc



Composition: coPP 82.8%, hPP 5%, Blk MB 2%, Mineral 10%, 0.2% AO



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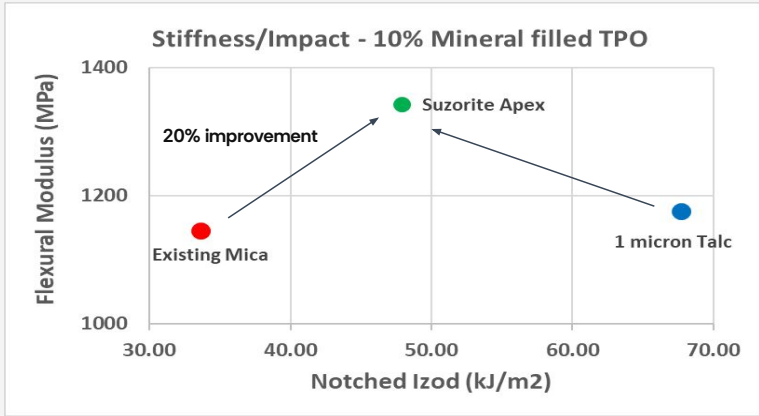


Composition: coPP 67.8%, hPP 5%, Blk MB 2%, Engage 8200 15%, Mineral 10%, 0.2% AO

New Suzorite™ Apex Benchmarked

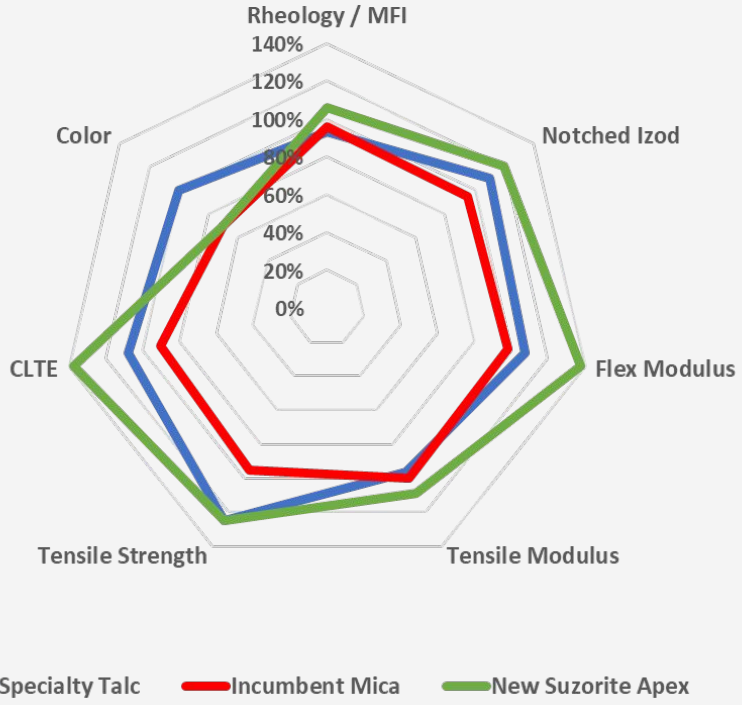
General Additive/Mineral attributes in PP

Attribute	Choped Glass Fiber	Specialty Talc	Incumbent Mica	New Suzorite Apex
Rheology / MFI				
Tesnile Modulus				
Tensile Strength				
Tensile Elongation				
Flex Modulus				
Notched Izod				
Instrumented Impact				
CLTE				
Isotropic Performance				
Warpage				
Color // Matching				
Carbon Footprint				

Best
Better
Limitation
Deficient

Suzorite™ Apex - strong lightweighting candidate for non color & impact sensitive applications. Has excellent reinforcing and dimensional stability attributes

30% Mineral Filled hPP



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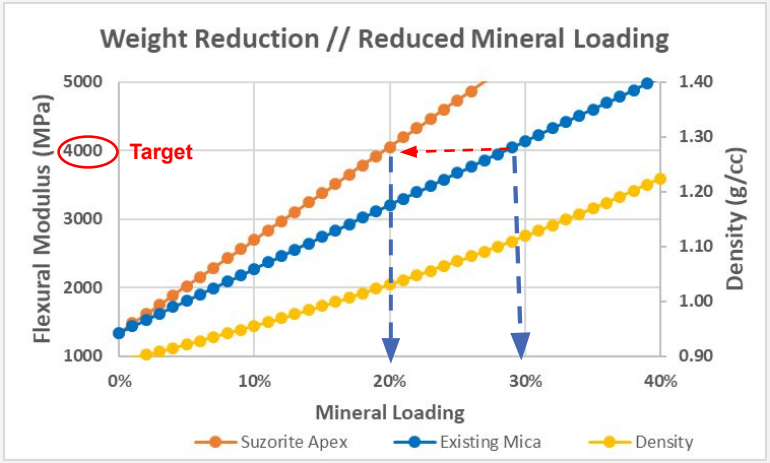
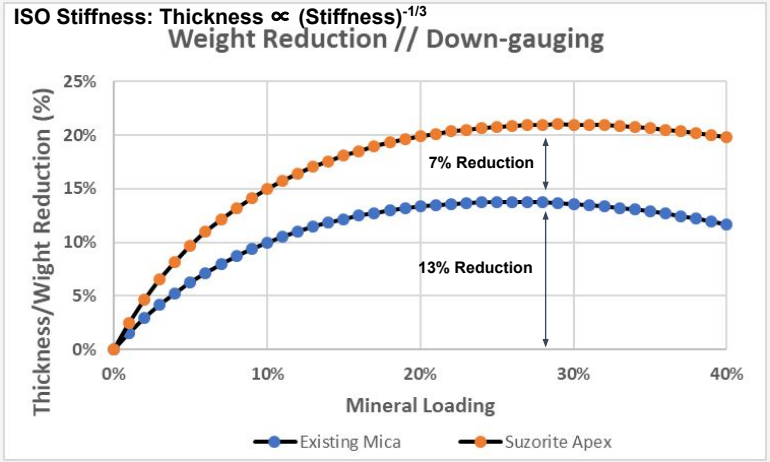
New Suzorite™ Apex for Lightweighting





Composition: h-PP, Mica, 0.2% AO

NEW Suzorite™ Apex enables Lightweighting via:

- **Reduced mineral loading:**
  - If target is 4000MPa, able to reduce Mica loading from ~30% to ~20% by using Suzorite™ Apex in place of incumbent
- **Down-gauging (part thickness reduction)**
  - Ability to reduce thickness/weight by an additional 7% with new Suzorite™ Apex // total of 20% possible

Case Study: Weight reduction in leaf screen

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Suzorite Mica - Thermal Shield & Flame Retardant Synergist

Thermal & Electrical

Suzorite Mica

Platy, high aspect ratio, high melting temp & electrical isolation

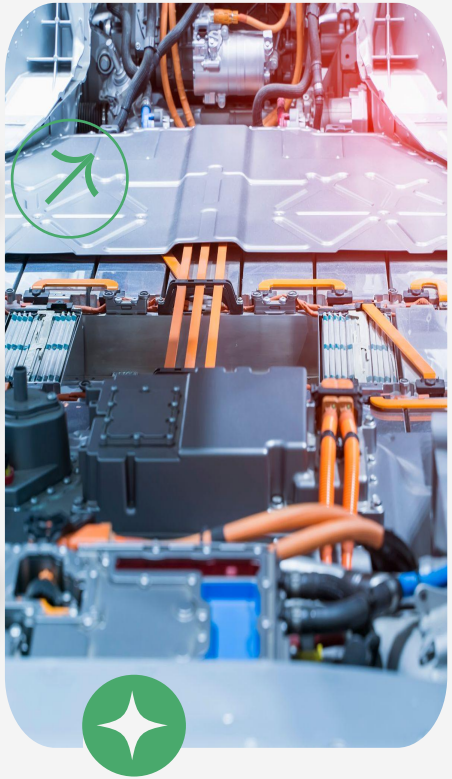
EV Battery Protection
High temp **thermal barrier** & **electrical isolation** in heat shield & mica tape

Reinforcement, Dimensional Stability & Flame Retardant Synergist in Thermoplastics

THERMAL & ELECTRICAL INSULATION

DIMENSIONAL STABILITY

REINFORCEMENT / LIGHTWEIGHTING



ImerShield™ Mineral based flame retardant synergist

PIONEER
Rated by Imerys
SustainAgility SOLUTIONS

Formulation	Control	ImerShield Solution	Control	ImerShield Solution
Polypropylene	70	70	60	60
ImerShield P2200	0	10	0	9
DBDPE // ATO Based FR			40	31
P&N/APP Based FR	30	20		
Total (%)	100	100	100	100
UL94 @ 3.2 mm	V0	V0	V0	V0

Imershield enables improved FR classification with reduction in both Halogenated and Non-Halogenated FR additives

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Responsible Sourcing of Phlogopite Mica in Canada

Sustainable Sourcing

- Imerys mines phlogopite Mica sourced exclusively in Canada
  - *Suzorite* is a trade name; coming from the township of Suzor where the mine is located
- Partnered with First Nations to develop historic win-win agreement
- Traceability of phlogopite Mica throughout the supply chain
- Processed at our ISO 9001:2015 QMS certified plant in Boucherville, CA, ensuring consistent quality and customer trust

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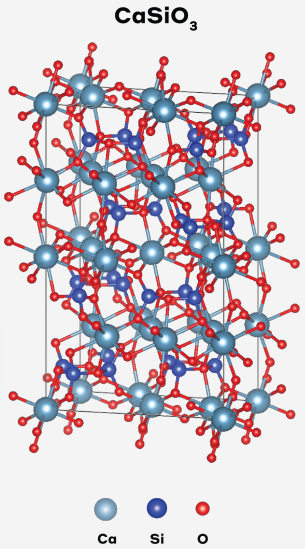
Wollastonite Properties and Structure



Mineral structure
Acicular

Physical Properties and benefits to applications

Stiffness/Impact	Retains weld-line strength
High thermal stability	Improves aesthetics
High brightness / White	Rheology retention

Production process
Wet primary process: Crushing > Flotation > Drying
Dry primary process: Crushing > Magnetic separation
Low Aspect Ratio: Pebble Milling > Air Classifying
High Aspect Ratio: ACM Milling > Jet Milling
For some applications, Silane Surface treatment

Key analytical properties (specification for production)
Relative Particle Size: 4x12 to 55x825 microns
Aspect Ratio 3:1 to 15:1
Brightness: 80 - 93
Density: 2.9 g/cc
Bulk Density: 0.2 to 0.8 g/cc

Imerys site origin
PM A: Willsboro US, Hermosillo Mexico

Main applications
Plastics, Metallurgy, Ceramics, Adhesives & Sealants, Paints & Coatings

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Next Gen. Mineral Reinforcement & Lightweighting TPO

OBJECTIVE

Improve reinforcing characteristics > 15% higher than what achieved with speciality 1 micron talc

MATERIALS

Minerals: 1 micron Talc, New Engineered HAR Wollastonite

Polymer: Formolene 2620A (co-PP Copolymer), F1000HC (High Crystalline hPP), Engage 8200 (POE), Blk PP MB - Avient, AO BB011

APPROACH

Processing: Melt compound via 25mm co-rotating/intermeshing TSE (46:1, L/D)

Molding: Standard ISO specimen prepared via 66T Arburg

Characterization: ISO (180, 527, 178, 75) test methods

New HAR Wollastonite

Talc

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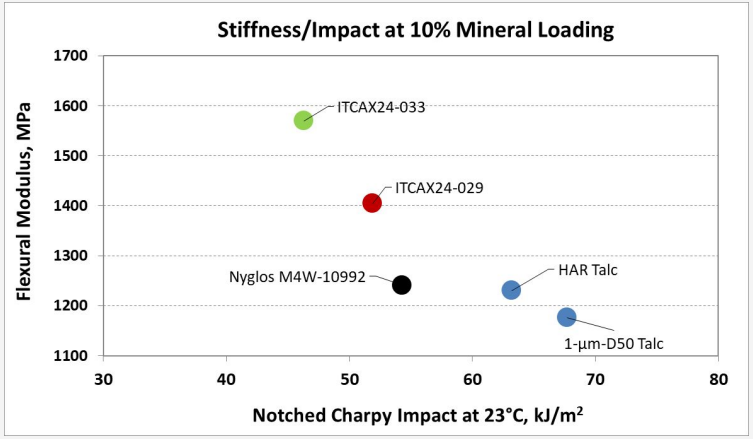
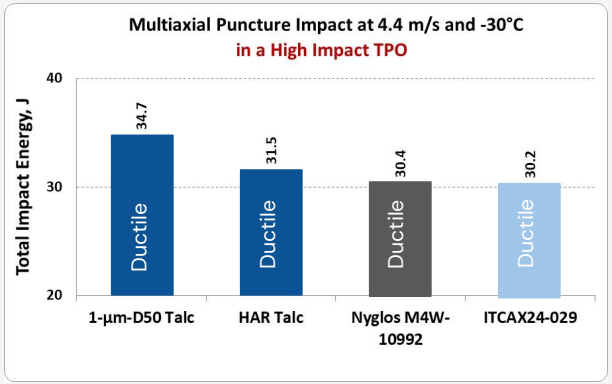
Next Gen. Mineral Reinforcement & Lightweighting TPO



Composition: coPP 67.8%, hPP 5%, Blk MB 2%, Engage 8200 15%, Mineral 10%, 0.2% AO



Imerys has developed a new wollastonite-based reinforcing additive for plastics, especially for PP/TPO formulations to maximize the reinforcement while maintaining the impact performance.

At 10% loading, the new **ITCAX24-029** increases stiffness by 13-19% compared to the best incumbent talc and wollastonite products in a high impact TPO formulation.

Multiaxial impact measurement at -30C and 4.4 m/s shows that ITCAX24-029 allows maintaining the impact ductility despite the significant increase in stiffness.

At 10% loading, the **ITCAX24-033** increases stiffness by 27-34% compared to the best incumbent talc and wollastonite products in a high impact TPO formulation,

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Minerals for Translucency Needs

OBJECTIVE

Assess influence of minerals on light transmission, while maintaining good balance of mechanical, Rheological and thermal properties.

MATERIALS

Minerals: One micron Talc, Developmental Wollastonite & Chopped Glass Fiber

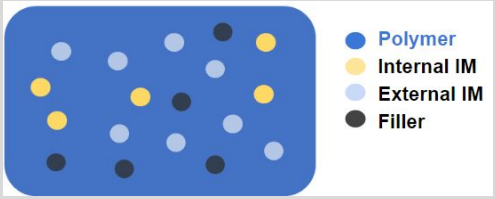
Polymer: PPC100RC-35M (Random PP Copolymer)

APPROACH

Processing: Melt compound via 25mm co-rotating/intermeshing TSE (46:1, L/D)
Molding: ASTM & ISO test specimen prepared via 66T Arburg injection molding unit
Characterization: Light transmission based on ASTM D1003 / mechanical properties (ISO 180, 527, 178, 75, etc)

Acura Precision Concept EV Source: Acura

Multi-component phase TPO



Factors influencing Light Transmission of TPO

- Refractive index
- Phase size
- Phase color
- Phase shape
- Phase concentration
- Matrix (crystallinity)
- Object dimension

Phase	Density (g/cm³)	Refractive index
PP matrix	~ 0.9	1.49
Ethylene based elastomer	0.84 – 0.88	-
Styrene based elastomer	0.9 – 0.91	-
Talc	2.78	~1.59
Wollastonite	2.9	~1.63
Phlogopite	2.73	~1.56-1.62
MOS	2.3	1.53
Glass fiber	2.54	1.558

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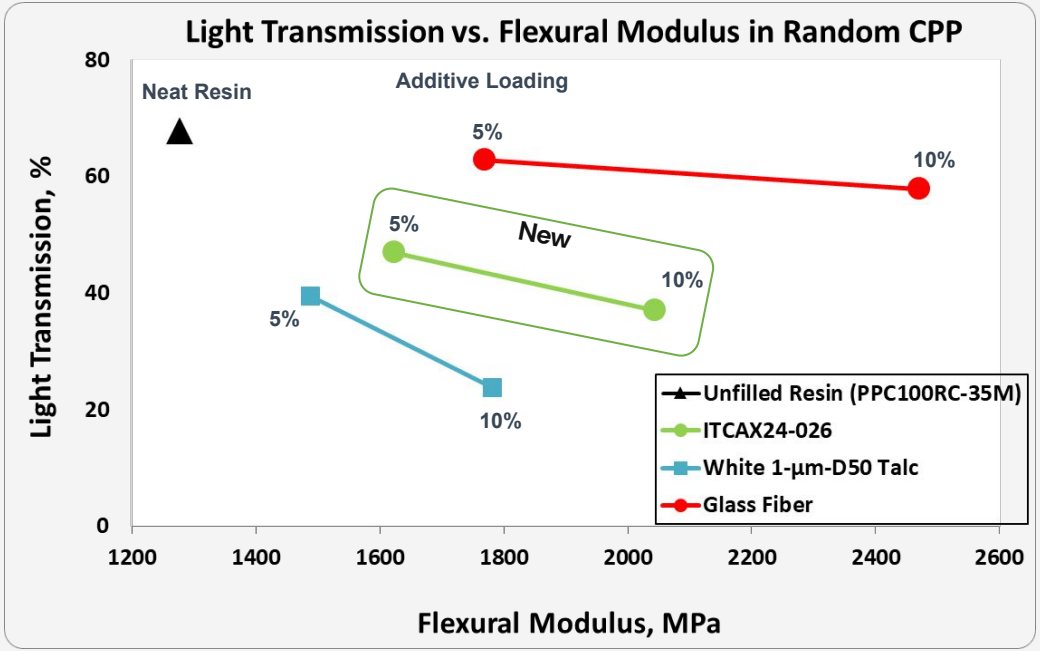
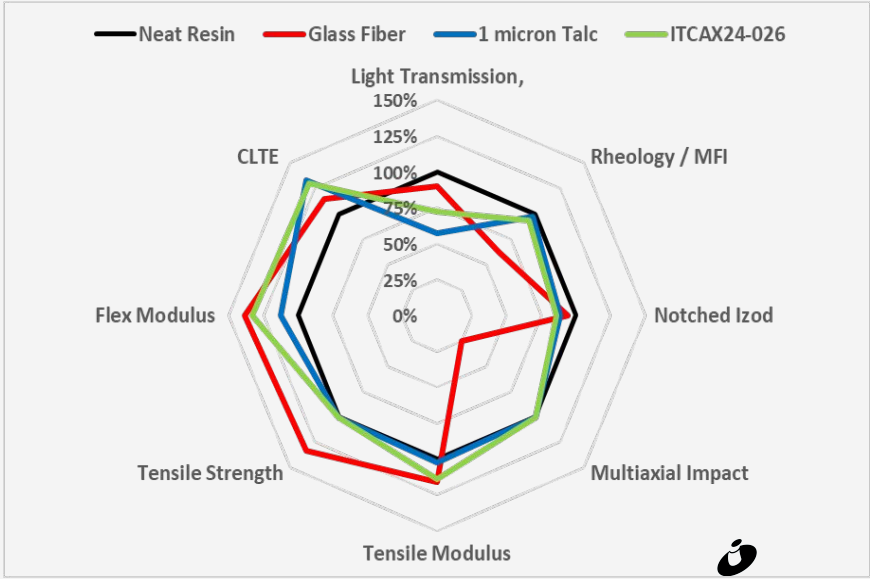
Minerals for Translucency Needs



Composition: 89.8-94.8% Random r-PP, 5-10% Mineral, 0.2% AO

Graph showcases the performance of **ITCAX24-026** designed for maximum transparency and good property balance

Imerys has developed new solutions for translucent PP/TPO formulations in order to allow increasing the stiffness and other mechanical properties of plastics, while maintaining elevated levels of transparency compared to the incumbent ultrafine talc solutions.



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Conclusions

Imerys is introducing new mineral solutions for automotive PP and TPO's based applications

01 Lightweighting PP

Suzorite™ Apex: Enables maximum stiffness // dimensional stability for limited impact & non-color sensitive applications

02 Lightweighting TPO

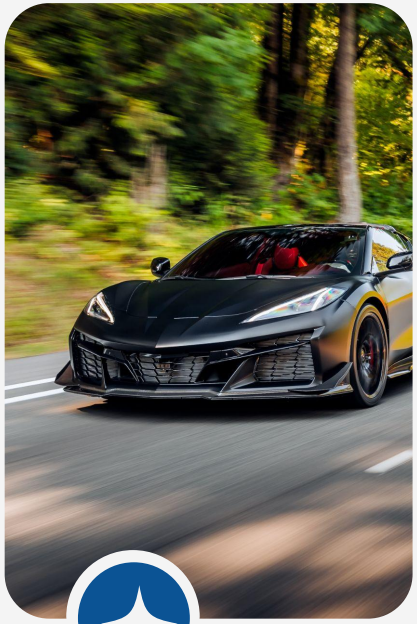
Developmental ITCAX24-029 & 033, HAR Wollastonite: Provides maximum stiffness // impact balance with good aesthetics & rheology

03 Translucent TPO

Developmental Wollastonite - ITCAX24-026: Supports higher light transmission while achieving desirable mechanical, rheological and thermal properties

04 Flame Retardant (FR) Synergist

ImerShield P2200: for flame retardant polyolefins: enables improved FR classification, cost savings, tailored mechanical properties



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Thank You For Your Attention

Do You Have Any Questions?

Let's Discuss It

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