

Applied Minerals is a leading global producer of Halloysite Clay. Vertically integrated from mine to market, our niche focus and in-depth application knowledge allow us to offer our customers commercially consistent product grades, specifically tailored to achieve their enhanced performance objectives. Applied Mineral's Halloysite products are offered under the Dragonite™ brand.

Applied Minerals is proud to introduce Dragonite-XR™, a drop-in additive specifically suited for polymer reinforcement. Dragonite-XR™ is naturally exfoliated due to its tubular shape and uniform surface charge. As a result, Dragonite-XR™ disperses easily in various thermoplastic and thermoset resins at loading levels up to 40%. This is a major advantage over layered silicate fillers that must undergo a complex and costly chemical exfoliation process. Dragonite-XR™ composites exhibit not only high stiffness but also higher tensile and flex strength, all with a lower density and retained toughness.



5µm |
SEM image of Dragonite-XR™



Dragonite-XR™
in powder form

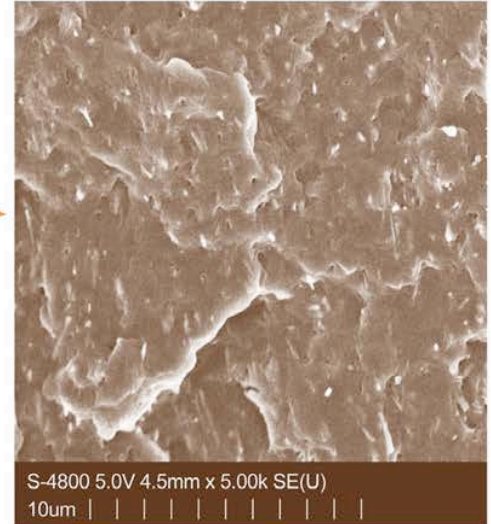
Advantages of Dragonite-XR™ in Composites

- Lower density than conventional fillers results in reduced weight of finished products.
- Naturally exfoliated morphology provides ease of dispersion at loadings up to 40% without a need for organo-treatment. This results in lower raw material, mixing, and quality control costs compared to organo clays.
- Increases both the stiffness (modulus) and strength of composite with minimal changes in impact strength, weld line strength, and viscosity.
- Improves fatigue resistance and drop impact resistance compared to chopped glass fibers.
- Acts as a nucleating agent with 8°C increase in crystallization temperature, even at 1-3 wt% level, resulting in faster cooling and cycle time.
- Improves thermal stability: 20°C increase in the decomposition temperature in TGA.
- Increases time to ignite, reduces peak heat release rate, and improves char density when added at 5-10 wt% with other conventional flame retardants.
- Lower shrinkage than organo clay and lower warpage than chopped glass fiber and mica.
- Increases stiffness and toughness of thermoset compounds.
- Tubular morphology enables the entrapment of active agents followed by their controlled-release at predetermined rates.
- Halloysite is an inorganic material that is non-toxic and biocompatible.
- Lower cost than organo clay.

Comparative Analysis

PROPERTIES OF PP HOMOPOLYMER WITH DRAGONITE-XR™

% Dragonite-XR™ (w/w)	Specific Gravity	Flex Modulus Kpsi	Tensile Strength psi	Flex Strength psi	Impact Strength ft-lb/inch
0	0.905	214	5581	6509	0.66
3	0.928	258	5913	7360	0.75
5	0.940	278	6113	7650	0.68
9	0.961	316	6150	8100	0.62
20	1.038	398	6003	8400	0.66
27	1.098	423	6177	8500	0.62



SEM image of PP composite with 20 wt% Dragonite-XR™

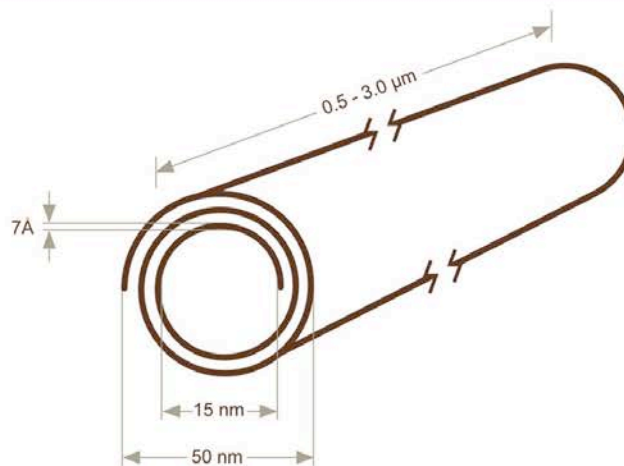
PROPERTIES OF NYLON 6 WITH DRAGONITE-XR™

% Dragonite-XR™ (w/w)	Specific Gravity	Flex Modulus Kpsi	Tensile Strength psi	Flex Strength psi	Impact Strength ft-lb/inch
0	1.130	348	10481	13243	1.20
3	1.149	466	12087	17621	0.72
7	1.163	495	12997	18100	0.94
13	1.182	533	13655	18900	0.86
24	1.297	731	14465	22653	0.77

PROPERTIES OF REINFORCED PP HOMOPOLYMER WITH 10% FILLER - SPECIFIC VALUES (VALUE/DENSITY)

Filler	Specific Gravity	Flex Modulus Kpsi	Tensile Strength psi	Flex Strength psi	Impact Strength ft-lb/inch	% Δ STRENGTH, PSI * % Δ MODULUS, KPSI
Polypropylene	0.905	196	5581	6509	0.81	0
Dragonite - XR™	0.961	329	6400	8429	0.73	0.0994
Chopped Glass Fibers	0.978	327	6449	8589	0.61	0.1041
Micro-Talc	0.973	338	6074	8181	0.84	0.0641
Wollastonite	0.980	266	5184	6214	0.84	-0.0255
Calcium Carbonate	0.975	256	4923	6769	1.13	-0.0363
Nanoclay - MMT	0.954	340	5615	7429	0.63	0.0045

More detailed information available upon request



The Dragon Mine: Applied Mineral's Wholly Owned Source of Halloysite

The Dragon Mine is located in the Tintic District of Utah stretching over 230 acres of land. Applied Minerals retained the world's leading experts in Halloysite to create a standard for the characterization, quantification, and commercialization of this unique mineral. As a result of these efforts, the Company is able to deliver commercially consistent product grades of the highest quality Halloysite in the world.

PATENTED TECHNOLOGY

US PROVISIONAL PATENT: Process for Polymer Composite with Inorganic Filler

US PATENT NO: 6,280,759 Method of Controlled Release and Controlled Release Microstructures

US PATENT NO: 5,492,696 Controlled Release Microstructures

US PATENT NO: 5,705,191 Sustained Delivery of Active Compounds From Tubules with Rational Control

US PATENT NO: 5,651,976 Controlled Release of Active Agents Using Inorganic Tubules



Applied Mineral's Dragon Mine: Utah, USA.

Other Dragonite™ Applications & Uses

Controlled Release Technology: As a carrier of active ingredients, the tubular nature of Dragonite™ Halloysite clay enables a product to maintain uniform and sustained release rates of an active agent, thereby reducing application frequency and initial overdosage. Release rates can be controlled through selection of tube diameter, length, and encapsulation. This increased efficiency of application reduces the amount of active agent needed to achieve desired results, translating into significant cost savings and environmental responsibility.

Applications for Controlled Release: paints/coatings, building materials, agriculture, cosmetics, fragrances, pigments, electronics, fabrics, textiles, drug delivery fields and a range of other industries.

Other Areas of Use: catalysts, molecular sieves, environmental remediation, filtration, technical ceramics, cosmetics, paint modifiers, tyre composites, proppants, drilling muds.