PLASTICS & RUBBERS

DELLITE NANOCLAYS FOR NANO COMPOSITES

LAVIOSA

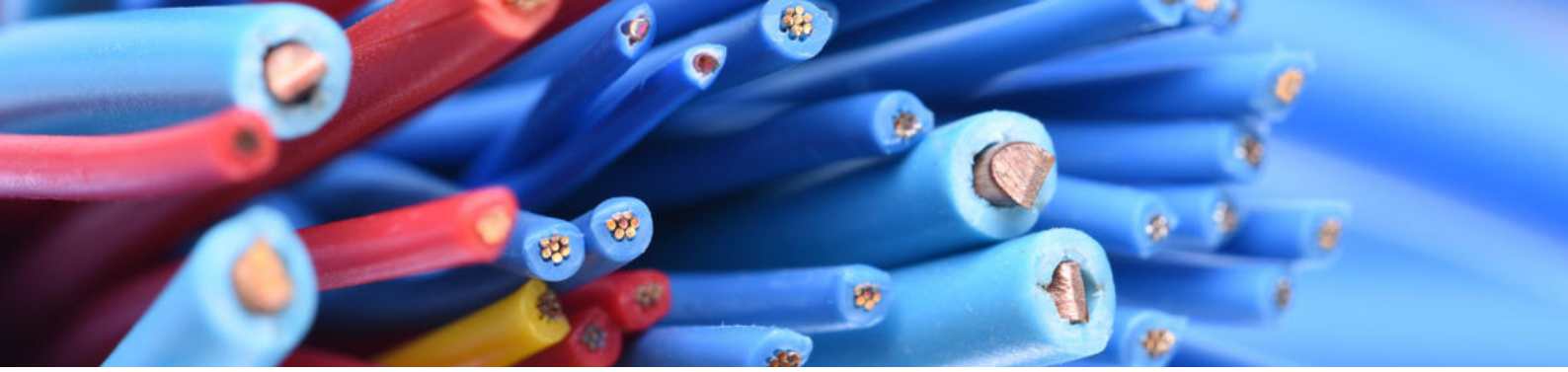
OUR **COMPANY**

Our core business consists in the research and transformation of bentonites and other clay minerals into **high added-value ideas and solutions.**
Control of raw materials, process technology, production localization around the world, product applicative expertise, integrated with logistic services and a customer oriented approach are our main strengths and capabilities.
We count more than 1500 customers in over 80 countries worldwide.
Other than in **Coatings and Plastics**, our special clays are used in Lining and Waterproofing Technologies, Civil Engineering, Drilling and Tunneling, Cat Litter, Foundry, House and Personal Care, Paper, Beverage and Animal Feed, Waste Water Treatment, Ceramic and others.
The key of our success lies in our people's constant attention to innovation, integrity, sustainability in a participative work environment.

WHAT IS **BENTONITE**

Bentonite is a clay mineral of the smectite group and is composed mainly of **montmorillonite**.
The smectites are a group of minerals that swell as they **absorb water or organic molecules** within the structural layers; they also have considerable cationic exchange properties.
The clay mineral they are composed of in the crystalline state is derived from the devitrification, and consequent chemical change, of glass of magmatic origin, usually tufa or volcanic ash (Ross and Shannon, 1926).
The nature and **volcanic origins** of bentonite deposits give rise to varieties of the mineral that are often extremely heterogeneous. The bentonites that are thus formed can be described as **sodium, calcium and acid bentonites**.

Find out more on our websites: www.laviosa.com/en



Nanocomposites benefits

FLAME RETARDANCY and THERMAL STABILITY

Formation of char is an effective method of increasing the fire resistance of materials. Magnesium dihydroxide (MDH) and aluminium trihydroxide (ATH) are among the most common flame retardants fillers in compounding, but during combustion they are not able to form a complete char that prevents the formation of burning drops.

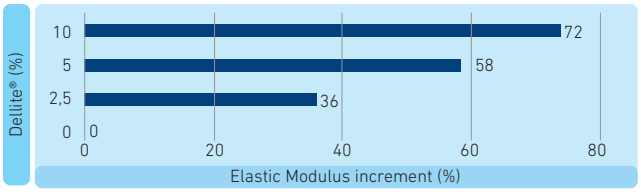
This can be achieved by the use of **Dellite**® products, synergic with flame retardant fillers, that increase the resistance to fire, prevent the dripping from the burning polymer and in some cases lead to self-extinguishing compounds. Every **Dellite**® grade has a particular behaviour that can improve elastic modulus or elongation at break, in some cases without affecting MFI.

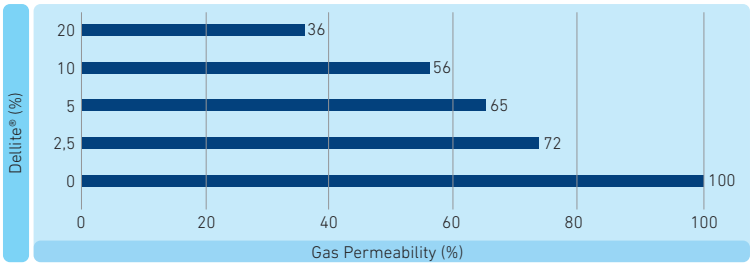
MECHANICAL PROPERTIES

The high surface ratio of **Dellite**® platelets contribute to increase the interaction between polymer chains. Some grades do not affect MFI increasing the elongation at break while other grades may increase the elastic modulus as below.

BARRIER PROPERTIES

A proper dispersion of **Dellite**® enhances barrier properties to O2, C=2 an vapor for example, by forming tortuous path for gas molecules permeating the polymer matrix.





EVA based HFFR	HF-0	HF-CW9	HF-72T	HF-C1S	HF-C2G	
EVA28 MFI=3 (ELVAX 265)	24	24	24	24	24	24
mLLDPE MFI=3-5 (EXCEED 3518)	10	10	10	10	10	10
LLDPE-g-MAH (FUSABOND E226)	4	4	4	4	4	4
fine pp ATH (MartinalOL104LEO)	60	58	58	58	58	58
Silicon MB (AL1142A plus)	1,5	1,5	1,5	1,5	1,5	1,5
Stabilizer (AE1527E)	0,5	0,5	0,5	0,5	0,5	0,5
Dellite CW9		2				
Dellite 72T			2			
Competitor 1				2		
Competitor 2					2	
Competitor 3						2
Vertical burning Test [1mm]						
Time 1. Top of the flame to high limit (s)	67	103	106	80	85	110
Time 2. Flame base to graduation line (s)	171	245	260	210	279	269
Presence of burning drops (YES/NO)	YES	NO	NO	NO	NO	NO
Starting time of burning drops (s)	32	-	-	-	-	-
Flame height (cm)	>20	18	17	20	18	19
Flame width at graduation line (cm)	9	7	6	9	7	6
Mechanical results						
Density at 23°C (g/cm3)	1,450	1,454	1,456	1,453	1,457	1,460
MFI – 21,6kg @160°C (g/10 min)	9,0	8,6	6,2	5,4	6,0	6,0
Tensile strength (MPa)	15,0	15,0	15,2	15,5	14,7	13,9
Elongation at break (%)	222	216	200	205	200	170
Tensile strength at 100% Elongation (MPa)	13,0	12,9	13,4	14,1	12,9	12,6
Tensile strength at 200% Elongation (MPa)	15,2	15,1	15,1	16,0	15,1	-

Dellite® grades

Dellite® grades	Organic modifier	Polymers
Dellite® 67G	DMDHT (high modifier content)	PP, PE, EVA, PA6, PA66, Rubber
Dellite® 72T	DMDHT (low modifier content)	PP, PE, EVA, PA6, PA66
Dellite® 43B	DMBHT	Epoxy, acrylic, and polyurethane resins, PBT
Dellite® CW9	DMDHT (high modifier content)	Polymers blend for cables (it may suit also other applications where transparency is not required)
Dellite® LVF	No organic modifier (low CEC)	Epoxy, acrylic, and polyurethane resins, PA6
Dellite® HPS	No organic modifier (high CEC)	Epoxy, and polyurethane resins, PA6
Dellite® JFD	No organic modifier (low hygroscopy)	Epoxy, acrylic, and polyurethane resins, PA6
Dellite®EFB	No organic modifier (low CEC)	PP, PE, EVA, PA6, PA66, Rubber, PVC

DMDHT diethyl-dihydrogenated tallow ammonium | **DMBHT** dimethyl-benzyl -hydrogenated tallow ammonium | **CEC** Cation Exchange Capacity

	Low polarity	Polimeric matrix	High polarity
Organic	Dellite® CW9 Dellite® 72T Dellite® 67G		Dellite® 43B
Inorganic		Dellite® EFB	Dellite® HPS Dellite® LVF Dellite® JFD

Polymer matrix compatibility with organoclay (organically modified montmorillonite) Dellite® and inorganic (montmorillonite) Dellite® products.

EVA based HFFR	HFC L00	HFC L1
EVA28 MFI=3 (ELVAX 265)	24	24
mLLDPE MFI=3-5 (EXCEED 3518)	6	6
LLDPE-g-MAH (FUSABOND E226)	4	4
fine pp ATH (MartinalOL104LEO)	54	54
Silicon MB (AL1142A plus)	1,5	1,5
Stabilizer (AE1527E)	0,5	0,5
Talc	10	-
Dellite EFB	-	10
TOTAL	100	100
Vertical burning Test [1mm]		
Time 1. Top of the flame to high limit	131	156
Time 2. Flame base to graduation line	227	248
Presence of burning drops	YES	NO
Starting time of burning drops	63	-
Flame height	19	18
Flame width at graduation line	10	9
Mechanical results		
Density at 23°C (g/cm³)	1,549	1,531
MFI – 21,6kg @160°C (g/10 min)	3,6	2,2
Tensile strength (MPa)	10,7	12,2
Elongation at break (%)	113	155
Tensile strength at 100% Elongation (MPa)	10,8	11,9

HFFR nanocomposites

POE-MDH-Dellite® composites for cables and wires

Polyolefin elastomers are widely use in cables and wires production, thanks to their great processability.

Typical formulation components	Blank (%)	Nanoclay formulation (%)
Engage 8003	24	24
mLLDPE	10	10
LLDPE-g-MAH	3,5	3,5
MDH	60	58
Silicon masterbatch	1,5	1,5
Stabilizer antioxidant	0,5	0,5
Anti-hydrolisis masterbatch	0,5	0,5
Dellite®		2

Engage 8003
ethylene-octene polyolefin elastomer

mLLDPE
metallocene Linear Low-Density Polyethylene

LLDPE-g-MAH
Maleic Anhydride grafted Linear Low-Density Polyethylene

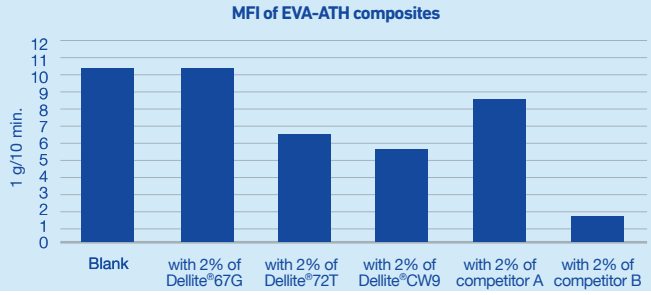
In low-polarity polymer matrixes, the most suitable Dellite® grades are 67G, 72T and CW9. Thank to synergic effect with the MDH, it is possible to achieve greater flame propagation time and anti-dripping.

Vertical fire test	Blank	Competitor A	Competitor B	Dellite® 67G	Dellite® 72T	Dellite® CW9
Flame Propagation Time 1) Top of the flame to high limit (s)	78	89	78	57	73	104
Flame Propagation Time 2) Flame base to graduation line (s)	160	268	290	206	231	247
Presence of burning drops	YES	NO	NO	NO	NO	NO
Starting time of burning drops (s)	141	-	-	-	-	-
Flame height (cm)	32	27	27	34	33	30
Flame width at graduation line (cm)	6	7	6	9	8	7

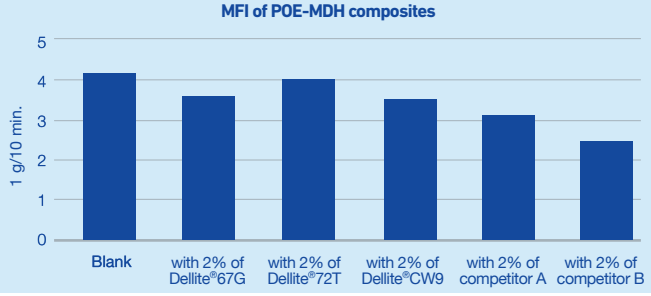
As in EVA matrix, has been observed not detrimental effect on mechanical properties, and, on the opposite, there is an increase in elongation at break.

Properties	Blank	Dellite® 67G	Dellite® 72T	Dellite® CW9
Density at 23°C (g/cm³)	1,445	1,430	1,428	1,434
Tensile strenght (MPa)	15,6	12,4	12,7	11,8
Elongation at break (%)	148	149	162	177

MFI
Melt Flow Index measured with a load of 21,6 kg at 190 °C (1 g/10 min.)



The mechanical properties and the processability of the polymer matrix are slightly affected by the addition of nanoclay fillers.
Using Dellite®CW9 an increase in elongation at break has been even observed.



Compared to the competitors, using Dellite® products still assure a greater processability, allowing no-changes in polymer production and processing (extrusion, injection molding, blow molding, etc.) parameters.

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Find out more about our certification standards on our web site.