ELEMENTIS

Sustainable Coating Solutions through Excellent Barrier Properties of Talc

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About Elementis

A GLOBAL SPECIALTY CHEMICALS COMPANY

ELEMENTIS

COMPANY OVERVIEW

- Established in **1844**
- Employes **>1,600** colleagues around the world
- 26 locations
  - **23** manufacturing plants
  - **3** innovation center
- 2021 sales revenue of **$880m**
- **World's largest** source of high-quality hectorite
- Supplier of high-performance natural **talc** with brands as **Finntalc, Plustalc, Microtalc**

SUSTAINABILITY AT ELEMENTIS

- Many of our products, including Talc, are derived from **natural minerals and renewable vegetable sources.**
- Elementis has been awarded with **Ecovadis Gold 2021** rating
- We are proud to participate in many social responsibility programs.

CDP DISCLOSURE INSIGHT ACTION · FTSE4Good · UN GLOBAL COMPACT · ALLIANCE FOR WATER STEWARDSHIP · KAIVOSVASTUU

Elementis Talc's sustainability profile

DIFFERENT SUSTAINABILITY ANGLES FOR DIVERSE COATINGS SOLUTIONS

LOW MANUFACTURING CARBON FOOTPRINT

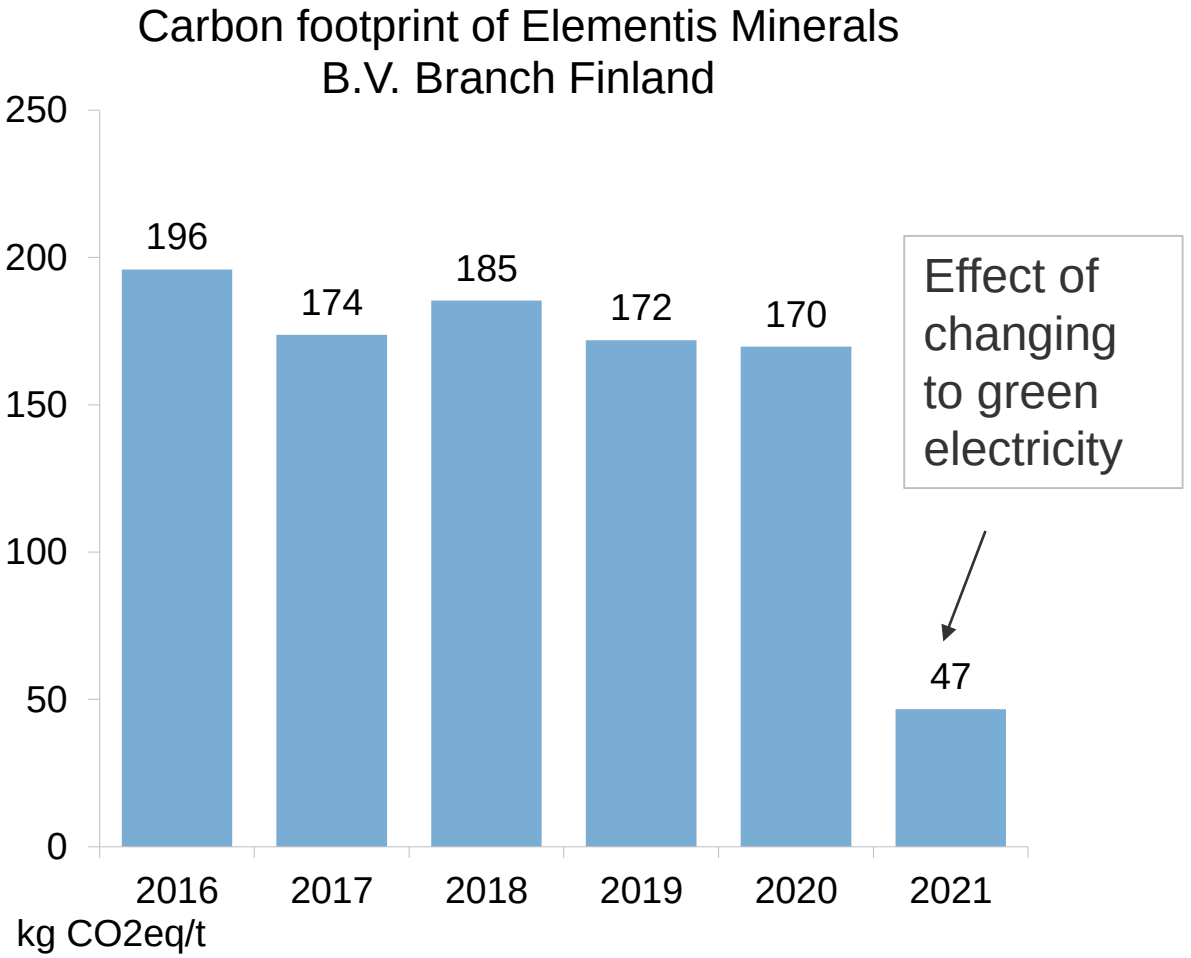
DESIGN FOR DURABILITY

SAFER HANDLING (DUST-FREE SOLUTIONS)

A path of continuous reduction of manufacturing footprint

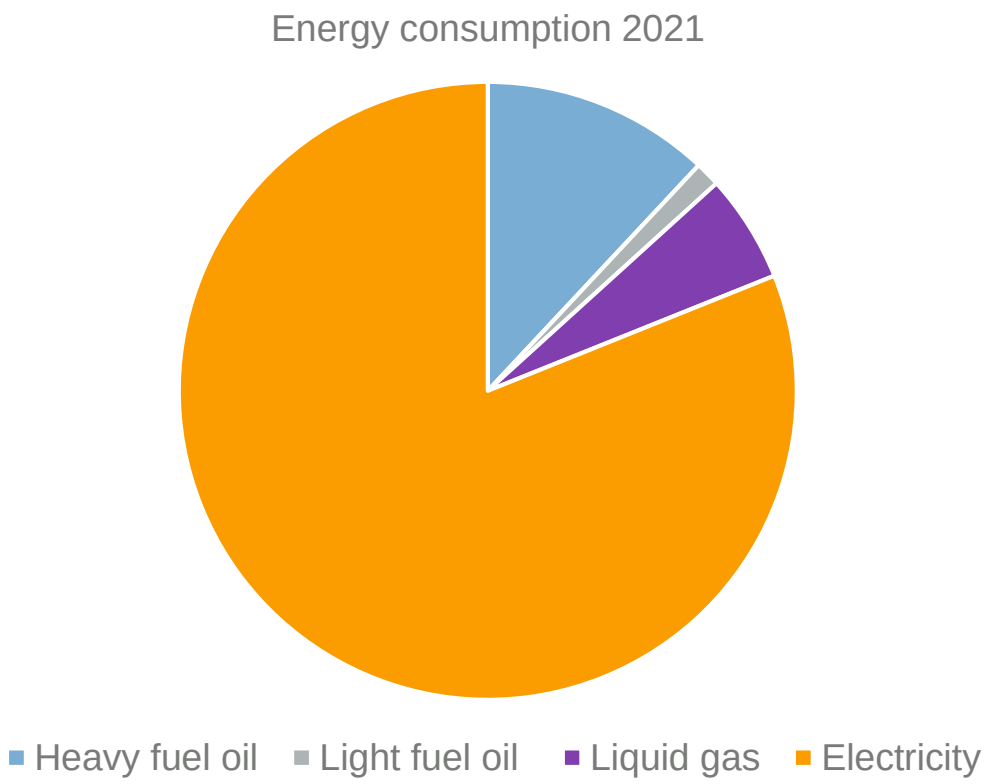
76% REDUCTION IN TALC'S CARBON FOOTPRINT SINCE 2016 (SCOPE 1&2)

- 100% of our electricity consumption comes from Certified Zero CO_2-emission Sources.
- We are working towards zero-waste production.
- Our mining meets *"Finnish toward sustainable mining (TSM) standard"*
- Zero wastewater. Water used in process is taken from mine (ground water, rainwater), purified and fed into closed water circulation.

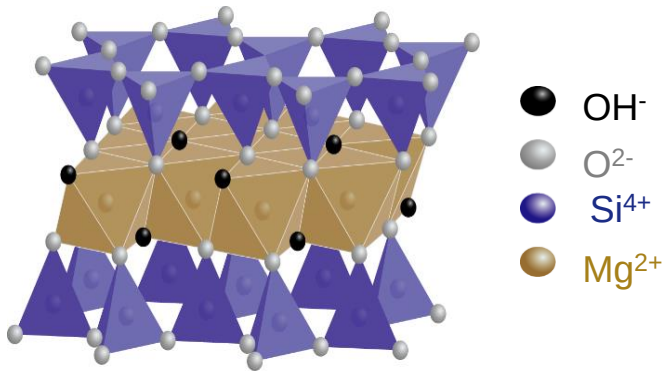


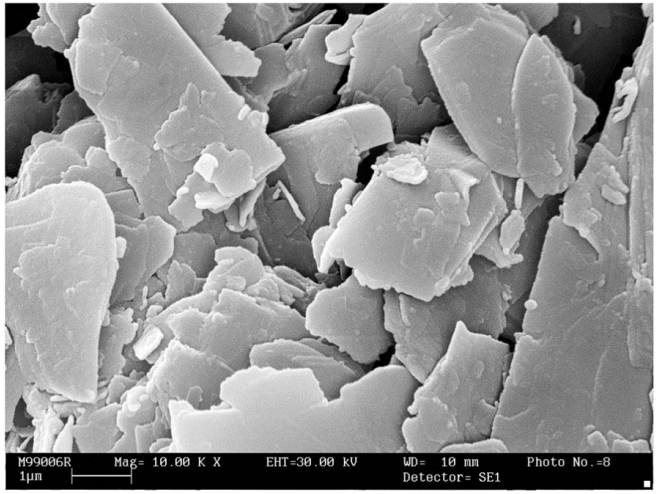
Carbon footprint of Elementis Talc's

- Carbon footprint calculations are based on total energy consumption of our operations
- Operations covers mining, refining (flotation), milling and packing
- In 2021 all our sites started to used green electricity with zero CO_2 emissions. The zero-emission statement is based on purchase of electricity with REC's (renewable energy certificate)



Elementis Talc's are inert, hydrophobic and platy





Talc is natural mineral with theoretical formula of $Mg_3Si_4O_{10}(OH)_2$.Elementis talc's **(Finntalc, Plustalc and Microtalc)** give excellent barrier properties for many end-use of coatings:

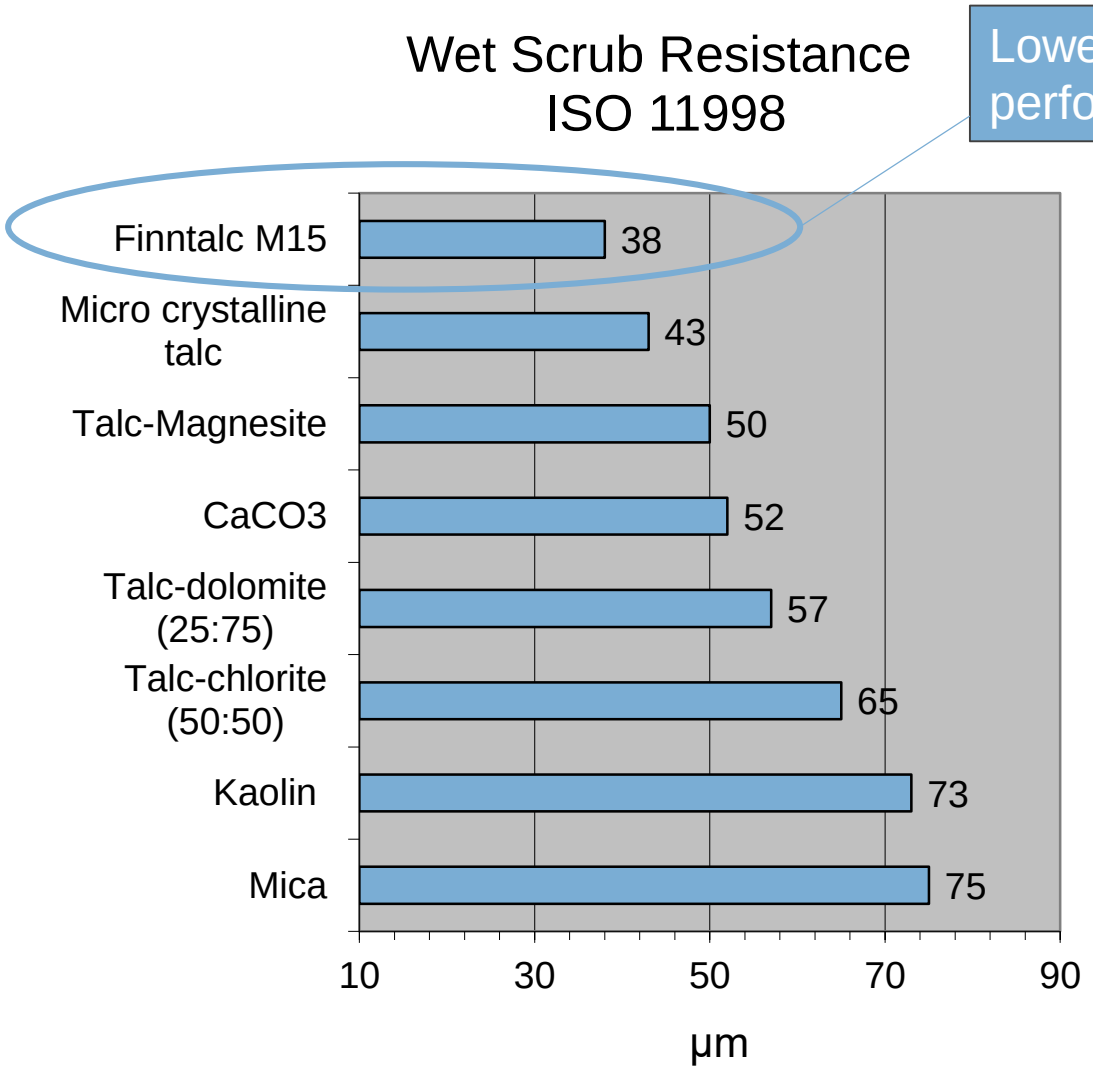
- **Improved wet scrub resistance**
- **Improved resistance to water, water vapor, O_2, CO_2, chemicals and stains (coffee, tea, red wine etc.)**
- **Improved corrosion resistance and outdoor durability**
- **Improved adhesion**

Finntalc M15 for architectural coatings

Key Benefits:

- Excellent wet scrub resistance
- Good barrier properties
- Good weather resistance
- Good balance of optical properties

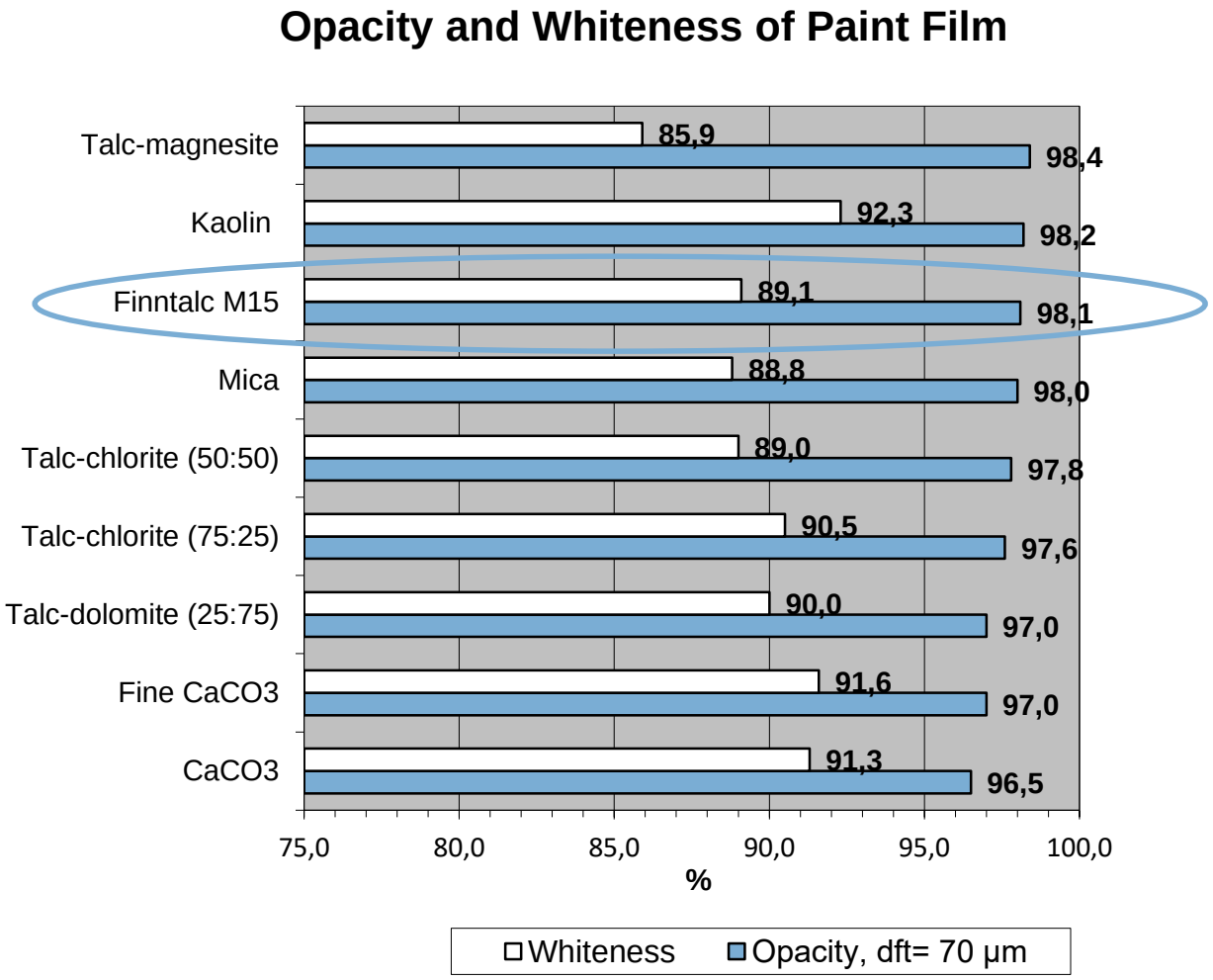
Wet scrub resistance – ISO 11998



Formulation data:

- PVC (tot)= 80 v%
- PVC (TiO_2) = 5 v%
- Solids by volume= 38 v%
- Binder= styrene-acrylate co-polymer
- Extender studied= 12 %

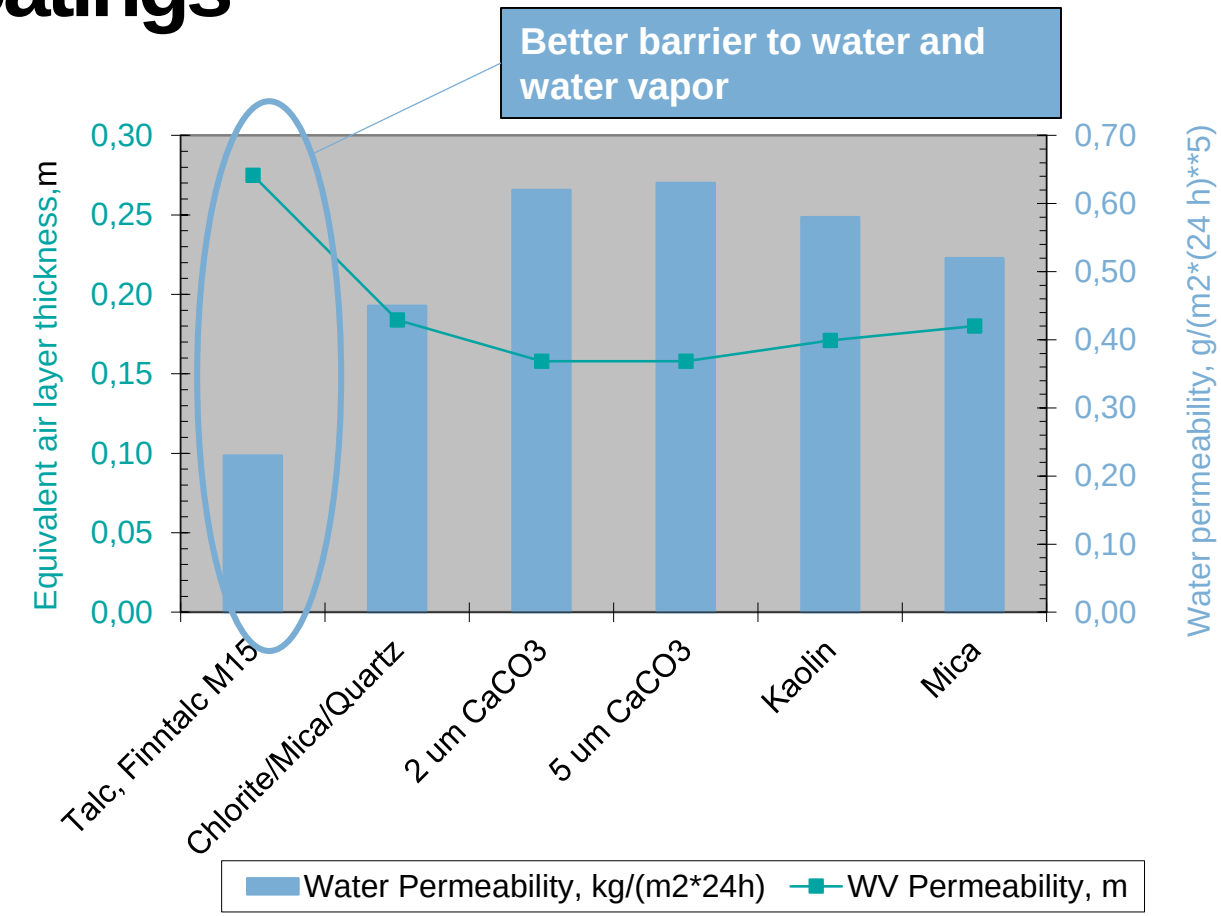
Optical properties of high PVC paint

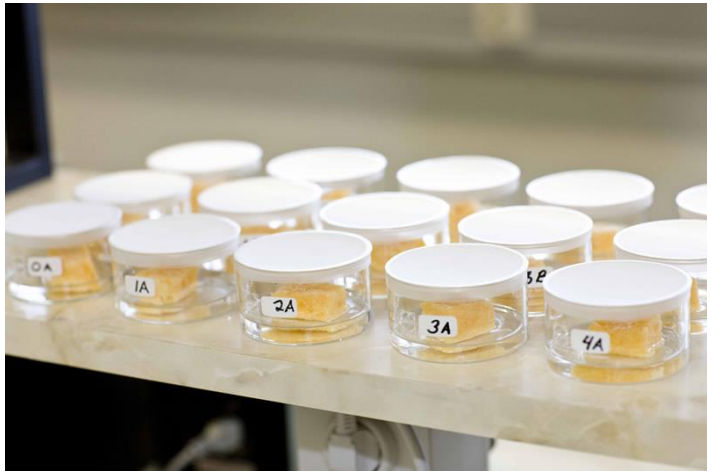


Darker the extender, better is hiding powder, but the whiteness is in many cases too low.

M15 give good balance of opacity and whiteness.

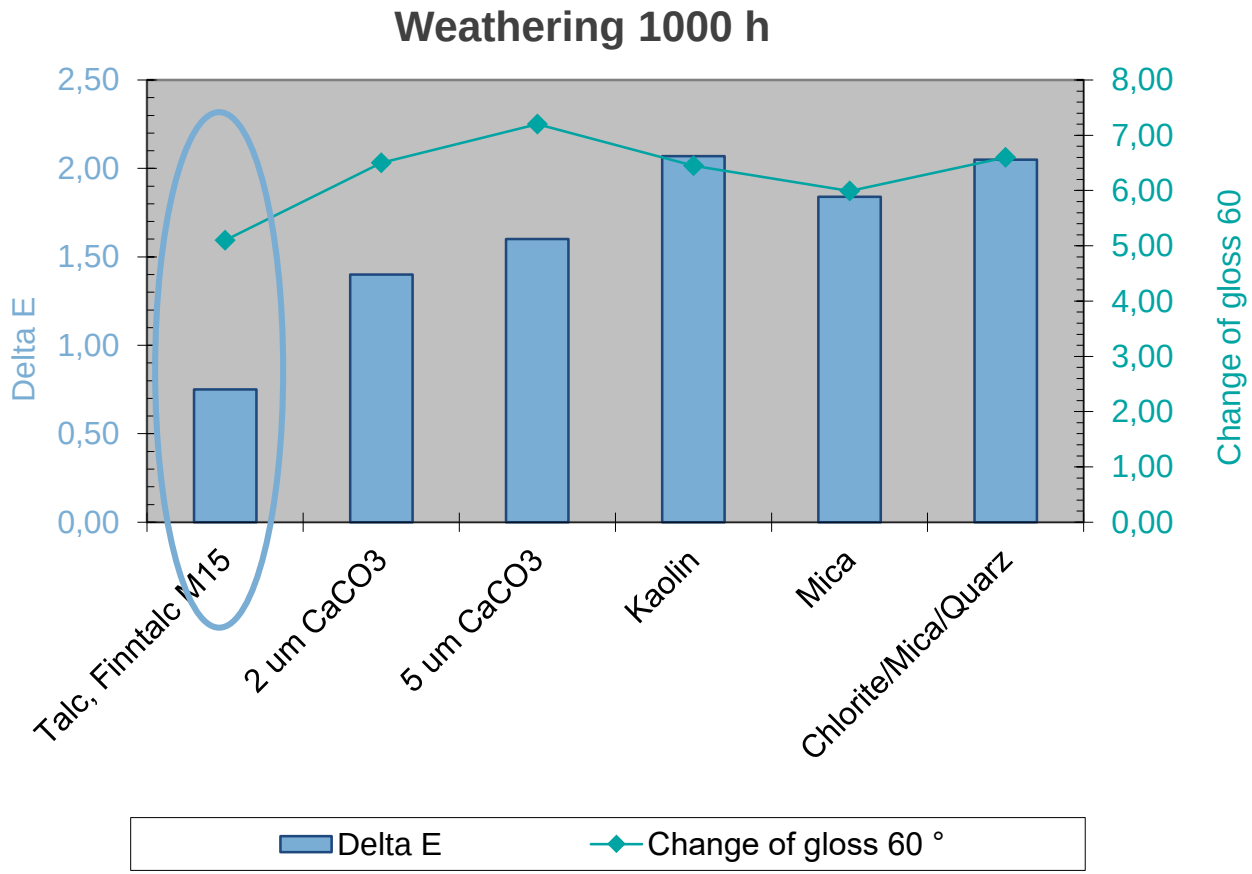
Water and water vapour permeability of low PVC wood coatings





Formulation data: PVC= 30v%, extender studied= 15 v%, TiO2= 20 v%, solids= 57 w%, acrylate binder

Weathering results of low PVC wood coating



Finntalc M65LV for heavy duty protective coating

Key Benefits:

- Excellent barrier properties giving good anti-corrosion properties
- Low VOC at reduced formulation costs and improved performance
- Good adhesion
- Good filling properties

Improvement of anti-corrosion properties by M65LV

- Elementis new product for heavy duty protective coating, **FINNTALC M65LV,** was tested against two main competition talc's
- Talc's varied in **mineralogical base** and in **particle form** (lamellar vs roundish particles)
- Paints were formulated:

  1) to the same **reduced PVC (Λ= 0.6)** from CPVC for each talc.

  2) Second series was done at **fixed PVC (45 v%)**.
- **Continuous neutral salt spray test** was run for 1440 h to reproduce the most **severe marine conditions**
- **Barrier properties** were tested by EIS (Electrochemical Impedance Spectroscopy).
- The study was executed by the external research laboratory VLCI.

	FINNTALC M65LV	Talc-Magnesite	Micro-crystalline talc
LOI, w%	6,1	12,4	5,4
HCl-solubles, w%	3,4	14,7	5,9
ISO-Brigthness, %	76,3	88,8	72,8
DIN-whiteness, %	78,3	90,7	76,4
CIE-values, L*	90,88	96,27	89,95
a*	-0,37	-0,05	-0,45
b*	1,8	1,4	3,1
Oil absorption, g/100 g	22	26	17
BET, m2/g	2,2	6,4	7,3
Top cut D98, µm	40	29	58
Average PS D50, µm	11,1	6,7	24,7

Formulations

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Ingredients	Finntalc M65LV w%	Talc-magnesite w%	Micro-crystalline talc w%	High PVC Finntalc M65LV w%	High PVC Micro-crystalline talc w%
Araldite GZ290x90	28,99	30,58	26,72	22,96	23,1
Dispersing agent	0,63	0,63	0,64	0,65	0,65
Xylene	9,82	9,91	9,69	9,48	9,48
TiO2	6,95	6,95	6,99	7,03	7,02
Iron-oxide pigment	0,87	0,87	0,87	0,88	0,88
Finntalc M65LV	**43,40**			**51,61**	
Talc-magnesite		**41,22**			
Micro-crystalline talc			**46,47**		**51,42**
Aradur 450	9,34	9,85	8,61	7,39	7,44
Total	100,0	100,0	100,0	100,0	100,0
Properties					
PVC	**35,75**	**33,51**	**39,07**	**45,05**	**44,81**
CPVC	59,55	55,80	65,06	59,63	65,14
Λ	**0,60**	**0,60**	**0,60**	**0,76**	**0,69**
% solids (wt)	86,91	86,67	87,26	87,85	87,83
% solids (vol)	**75,00**	**75,00**	**75,00**	**75,00**	**75,00**
Mix viscosity at shear rate 50 rpm, mPas	1700	1680	1015	4880	1650

Interpretation of EIS results

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Good	Standard	Bad
$R_c > 10^8\ \Omega\ cm^2$	$R_c = 10^7 - 10^8\ \Omega$	$R_c < 10^7\ \Omega$ cm2,
$Y_0 < 1 \cdot 10^{-10}\ s^n\ \Omega$	$Y_0 = 1\text{-}3 \cdot 10^{-10}\ s^n\ \Omega$	$Y_0 > 3 \cdot 10^{-10}\ s^n\ \Omega$
$n > 0,95$	$n = 0,90 - 0.95$	$n < 0,9$
$\Phi_{24h} < 0,1$	$\Phi_{24h} = 0,1 - 0,2$	$\Phi_{24h} > 0,2$

Best barrier properties by EIS measurement

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Talc	*Λ, Reduced PVC from CPVC*	Actual PVC	R_e, Electorolyte resistance	$R_{c,\ 504h}$, Resistance of coating to ion transportation after 504 h testing time	Y_0, Capasitance at the starts of measurement	n, number that discribes the deviation from ideal coating, lower the value worse is the coating, n=1 is ideal.	Φ_{24h}, Volume fraction of water absorbed by coating after 24 h testing time.	Summary of EIS
	-	v%	($\Omega \cdot cm^2$)	($\Omega \cdot cm^2$)	($s^n \cdot \Omega^{-1}$)		24h	
FINNTALC M65LV	0,6	32,5	$1 \cdot 10^2$	$1.08 \cdot 10^8$	$1.49 \cdot 10^{-10}$	0.940	0.13	+
Talc-magnesite	0,6	33,5	$1 \cdot 10^2$	$4.57 \cdot 10^7$	$2.99 \cdot 10^{-10}$	0.895	0.19	+ / -
Micro-crystalline talc	0,6	39,1	$1 \cdot 10^2$	$4.51 \cdot 10^7$	$3.89 \cdot 10^{-10}$	0.888	0.26	- -
FINNTALC M65LV	0,76	45,1	$1 \cdot 10^2$	$1.24 \cdot 10^8$	$1.28 \cdot 10^{-10}$	0.932	0.09	+ +
Micro-crystalline talc	0,69	44,8	$1 \cdot 10^2$	$5.24 \cdot 10^7$	$3.09 \cdot 10^{-10}$	0.877	0.24	- -

Salt-spray results

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Talc	Λ	PVC	Mean coating thickness (µm)	Blisters ISO 4628-2	Creep (mm) ISO 4628-3
Finntalc M65LV	0.60	35.8	127 ± 5	0(S0)	2,4
Talc-magnesite	0.60	33.5	94 ± 14	0(S0)	2,3
Micro-crystalline talc	0.60	39.1	131 ± 26	0(S0)	2,6
Finntalc M65LV	0.76	45.1	159 ±15	0(S0)	3,3
Micro-crystalline talc	0.69	44.8	176 ± 20	0(S0)	3,1

Summary of performances of Finntalc M65LV

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Talc	Λ / PVC	EIS	Saltspray	Summary of results	Ranking
Finntalc M65LV	0.60 / 35.8	+	+	+	1
High PVC Finntalc M65LV	0.76 / 45.0	++	+/-	+	2
Talc-magnesite	0.60 / 33.5	+/-	+	+/-	3
Micro-crystalline talc	0.60 / 39.1	- -	+	-	4
High PVC Micro-crystalline talc	0.69 / 44.8	- -	+/-	-	5

- Gives the **best barrier properties by EIS-measurement**. The barrier properties even improved with **increasing PVC**
- The coating performance fulfilled the marine standard **without anti-corrosion pigments** and only by **one coating layer !**
- **Finntalc M65LV** is deal extender for **low VOC coatings** for **severe conditions** like marine coating
- **Reduced formulation cost** by increasing PVC and/or solids without increasing application viscosity and at the same time **corrosion protection is improved**

Summary

ELEMENTIS talc's are inert, hydrophobic and lamellar in particle form, so they improve many paints and and coatings properties:

- ❖ Improve wet scrub resistance & outdoor durability
- ❖ Good balance of optical properties
- ❖ Improve adhesion
- ❖ Improve barrier properties to water and water vapour
- ❖ Improve stain resistance
- ❖ Improve chemical and corrosion resistance

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