ADD MONDO MINERALS TO YOUR IDEAS

Matt, Class 2 Wall Paint by Mondo Minerals Talc

Technical Bulletin 1204

CONTENTS

INTRODUCTION

Talc is, after calcium carbonate, the second most widely used extender in interior decorative paints. It is not used to cheapen the paint formulation, but really to improve the performance. Talc is a special extender; its surface is very hydrophobic and the particle form is lamellar.

These two properties are typical of pure talc (steatite). But not all talc grades on the market are the same. Each talc deposit has its own characteristics, like fingerprints. The talc can be more or less lamellar (macro- or micro-crystalline) and contain different secondary minerals, often chlorite (Mg-Al-silicate), magnesite ($MgCO_3$) or dolomite. These differences have marked effects on the properties of interior paints. The purpose of this study was to clarify the effect of different types and fineness of talc on the most important interior paint properties.

The durability of the paint film is largely defined by the wet scrub resistance. European standard, EN 13300, divides interior wall and ceiling paints into five different classes according to their wet scrub resistance, measured according to the ISO 11998 standard.

The wet scrub resistance in this ISO standard is determined as the loss of paint film thickness in µm. The classes are the following:

CLASS	LOSS OF FILM THICKNESS IN µm	NUMBER OF SCRUB CYCLES
1	0–5	200
2	6–19	200
3	20–70	200
4	<70	40
5	≥70	40

This bulletin describes how the choice of suitable extenders enables a class 2 paint to be formulated in a very cost efficient way. The wet scrub resistance was measured according to ISO 11998.

DESCRIPTION OF TRIALS

DIFFERENCES BETWEEN TALC GRADES TESTED

In this study, the typical paint talc grades of MONDO MINERALS were compared with commonly used competitive products. The talc grades tested varied in their mineralogical base, in morphology (macro- vs. micro-crystalline), in particle size and in brightness. So all the important talc properties were varied to determine their impact on the paint performance.

Three products were selected for this study: two from the talc range of MONDO MINERALS from Finland, FINNTALC M15 and FINNTALC M20SL, and one based on Asian raw materials, PLUSTALC H15. FINNTALC grades are macro-crystalline and purified by flotation. Flotation is a wet process involving several steps to separate the talc (steatite) from the other minerals present in the basic rock. Firstly, the raw material is milled to separate the different minerals into discrete particles. This is fed together with water and certain chemicals into a big tank. Air is blown into the bottom of this tank. The talc particles accumulate on the surface of the air bubbles, which then carry them to the top of the tank.

The froth (see Photo 1), which contains most of the talc, is scraped off and collected. The other minerals sink to the bottom of the tank. This process is repeated three times. The purified mineral is then milled to the final particle size.

FINNTALC SL (SL = super light) grades are additionally purified by a super magnetic separator, which removes nearly all the magnetic impurities. This improves the quality of the FINNTALC SL grades even further so that they are the purest on the market.

The other type of MONDO MINERALS talc in this study was PLUSTALC. This group of products is based on pure Asian-based macro-crystalline raw material. The raw material for PLUSTALC grades is naturally so pure that it does not need flotation.

The other talc grades tested in this study were chlorite-rich talcs. Chlorite is a magnesium aluminium silicate (Mg-Al-silicate) and has a hydrophilic surface. The chlorite content of the talc grades used varied from 10 to 55 % by weight. The content of the other minerals was fairly constant. Each talc grade contained only a few per cent of carbonate minerals. When different talc types were tested, the particle size of the different talc grades was fairly similar for all paints; the average particle size was around 5 µm. Coarser grades were also tested to see how the particle size affected the optical and other paint properties.

There was also one so-called micro-crystalline (low aspect ratio) talc in the comparison to demonstrate the effect of particle form on paint properties. The impact of talc's brightness on the paint properties was also studied. The brightness of the grades tested varied from 75 % to 93 %.

The properties of medium-fine (D50 = 5 µm) and coarse (D50 = 10 µm) talc grades used are given in Appendix 1 and 2.

Photo 1: Flotation tank

EXPERIMENTAL PROCEDURE

Firstly, two talc grades were tested in paints at different pigment volume concentrations (PVC) to see how the wet scrub resistance (WSR) was affected by the PVC. Then, paints were prepared with a PVC of 70 %, containing the various talcs being tested. The WSR of each paint was determined. The basic paint formulation is given in the table opposite.

The same basic formulation was used in the trial to investigate the effects of different PVCs by merely adjusting the binder content as necessary.

The paint properties measured are given in Table 1 with their target values.

COMPONENT	% WT.
Natrosol 250 HHR (2 %)	20.00
Coatex P50 (40 %)	0.30
Calgon N (10 %)	1.00
Ammonia (2.5 %)	1.00
Byk 033	0.30
Acticide MBS	0.20
TiO_2	5.20
Texanol	1.00
$CaCO_3$ D50 = 5 µm	5.00
$CaCO_3$ D50 = 2 µm	25.00
Talc	15.00
Water	9.90
Acronal 290D	15.80
Byk 033	0.10
Acrysol TT 935	0.20
	100.00
PVC (total), %	70.00
PVC (TiO_2), %	5.00
Solids by volume, %	37.50
Solids by weight, %	58.10
Density, g/cm^3	1.47

PROPERTY	METHOD	TARGET
Wet scrub resistance	ISO 11998	Class 2 of EN 13 300, reduction in paint film thickness = 5–20 µm
Contrast ratio	ISO 6504-3	Highest possible at spreading rate of 7.5 m^2/l
Whiteness of paint film	ISO 6504-3	> 85 %
Gloss 85°	EN ISO 2813	< 5 (dead matt)
Mud cracking	Internal test method: thickest possible crack-free paint film, dry film thickness in µm	Highest possible, 400 µm is minimum
Viscosity	Brookfield 100 rpm and 1 rpm	Lowest possible Br100 value and highest possible Br1: B100 ratio

Table 1: Paint properties measured and the target values

RESULTS AND DISCUSSIONS

The detailed analyses of the different talcs used are presented in Appendix 1 and 2. The results of the paint tests are given in tabular form in Appendix 3 and 4.

WET SCRUB RESISTANCE

In Figure 1, the wet scrub resistance results at different PVCs are shown. Figure 2 shows the scrub resistance of paints containing different types of talc at constant PVC. Figure 1 shows that pure macro-crystalline talc gives better wet scrub resistance values than chlorite-rich talc in the whole PVC range tested. The hydrophobic surface of pure talc results in the superior wet scrub resistance in comparison to chlorite-rich talc.

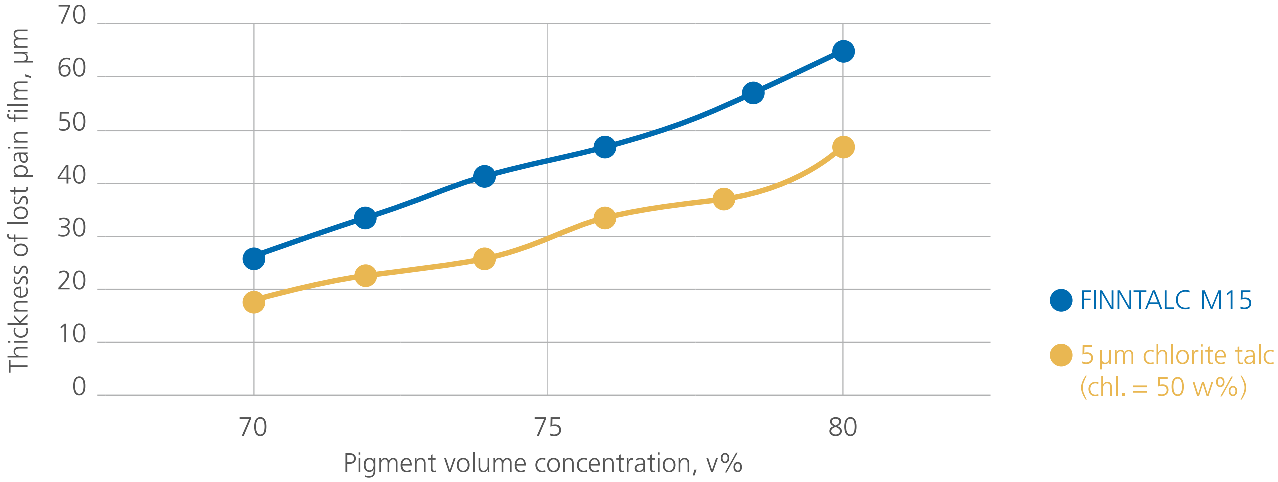

Figure 1: Wet scrub resistance according to ISO 11998 for different types of talc at various pigment volume concentrations

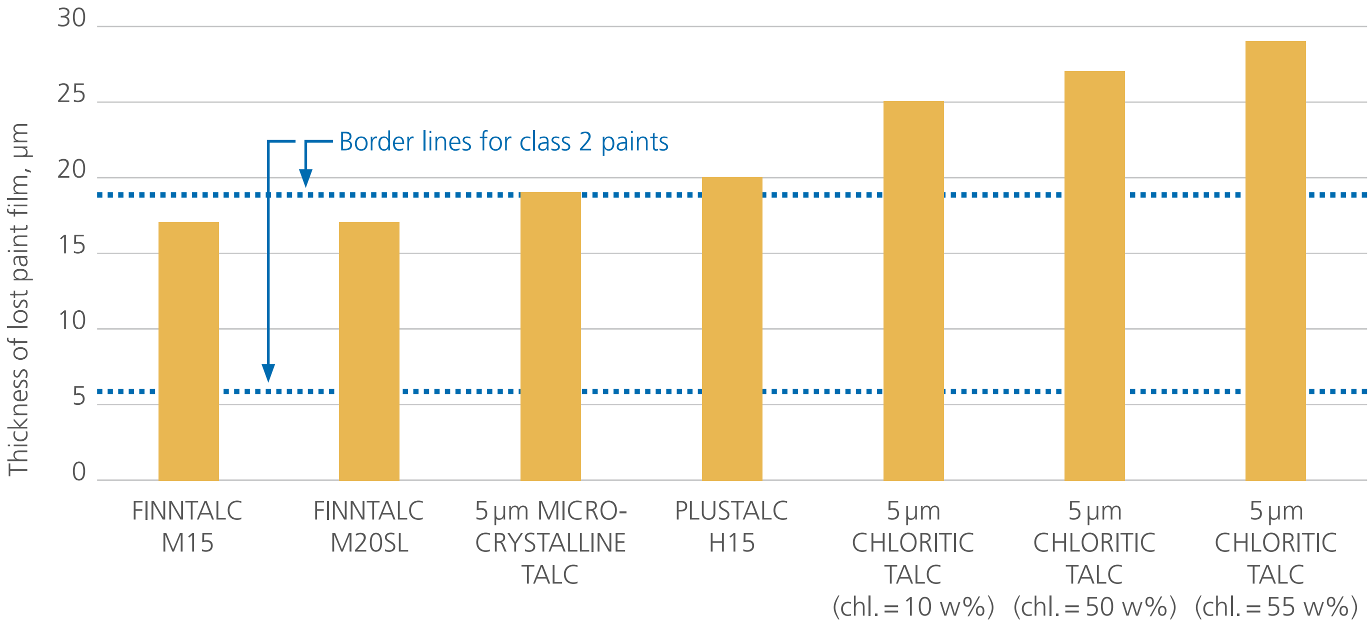

Figure 2: Wet scrub resistance of different types of talc at PVC of 70 %

Figure 2 shows clearly that the presence of chlorite in the talc worsens the wet scrub resistance; the higher the chlorite content, the worse the scrub resistance. Conversely, pure talcs give excellent wet scrub resistance.

The fineness of talc has a small effect on the wet scrub resistance, as shown in Figure 3. The coarser grades give slightly higher values than the finer grades.

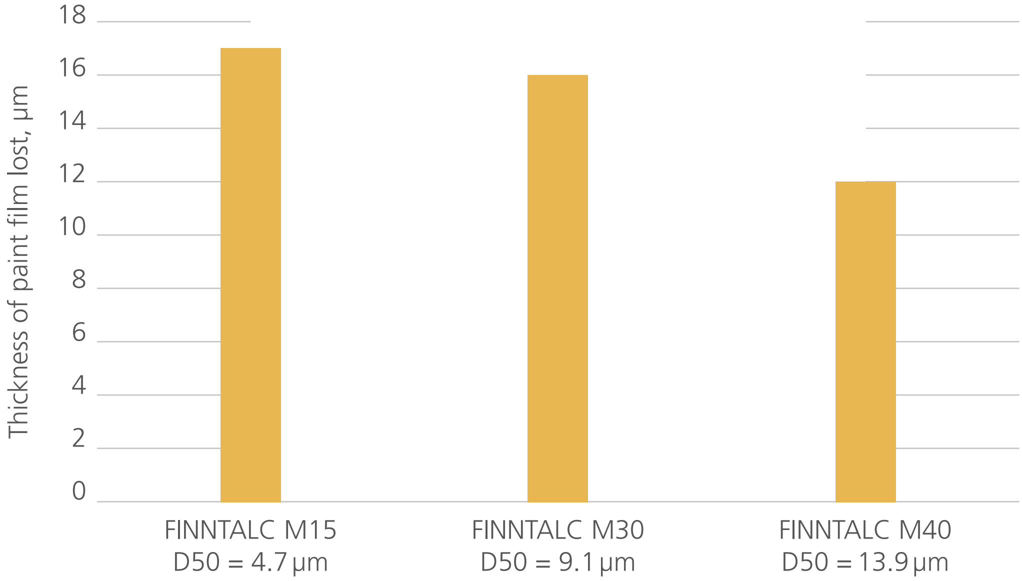

Figure 3: Effect of fineness of talc on the wet scrub resistance (ISO 11998) at a PVC of 70 %

OPTICAL PROPERTIES – HIDING POWER, WHITENESS AND GLOSS

The optical properties are most important for decorative paints. The paint film must hide the substrate to which it is applied. The whiteness and gloss must also lie within the target ranges. The formulation used in this study was a dead-matt interior paint, so the target sheen value had to be below 5. Many paint producers require a minimum value of 85 % for paint film whiteness. So the best talc is the one that gives a paint the optical performance that complies with these whiteness and gloss limits and also gives the highest hiding power (contrast ratio at a spreading rate of 7.5 m^2/l).

Only one type of talc in the formulation was changed for each paint, so the brightness and particle size distribution of that talc were the only factors causing variations in the contrast ratio and the whiteness of the paint film. The hiding power and whiteness of a paint film are, to a certain extent, opposing properties: the darker the paint film, the higher the hiding power and vice versa. These two properties have to be balanced so that both are at acceptable levels whilst maintaining the right gloss level. In Figure 4, the effect of talc type on these important optical properties is demonstrated.

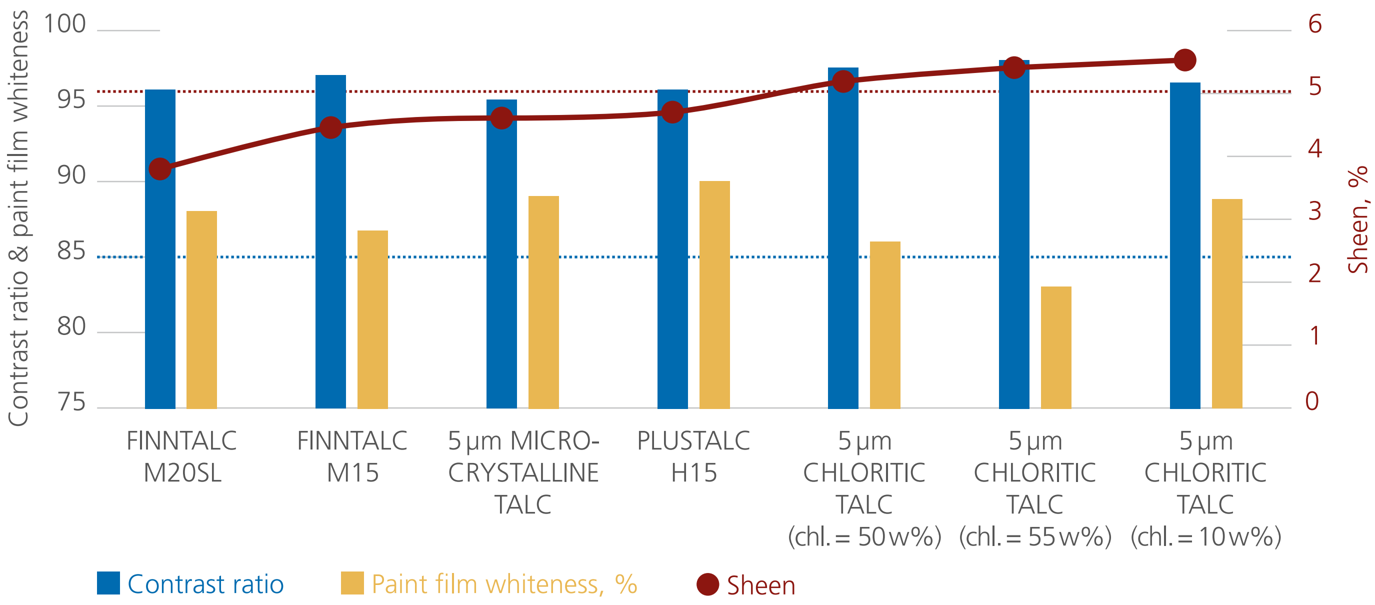

Figure 4: The effect of talc type on the optical properties of the paint film at a PVC of 70 % and contrast ratio at SR of 7.5 m²/l

FINNTALC M20SL showed the best balance of the optical properties. Also FINNTALC M15, micro-crystalline talc and PLUSTALC H15 gave acceptable results. There were small differences in the optical properties of these talc grades, which were mainly caused by the difference in the brightness of the various talc grades.

The particle size and size distribution clearly affect the optical properties. The effect of the fineness of talc on the optical properties of paint film and the whiteness of the talc itself are shown in Figure 5. To assess the effect of the fineness, talc grades were chosen that had the same mineralogical base to eliminate differences arising from other factors such as the purity. FINNTALC grades made from standard talc raw material were selected. As can be seen from Figure 5, the effect is linear; the coarser the extender, the lower the hiding power and whiteness of the paint film. The brightness of the extender decreases as the particle size increases.

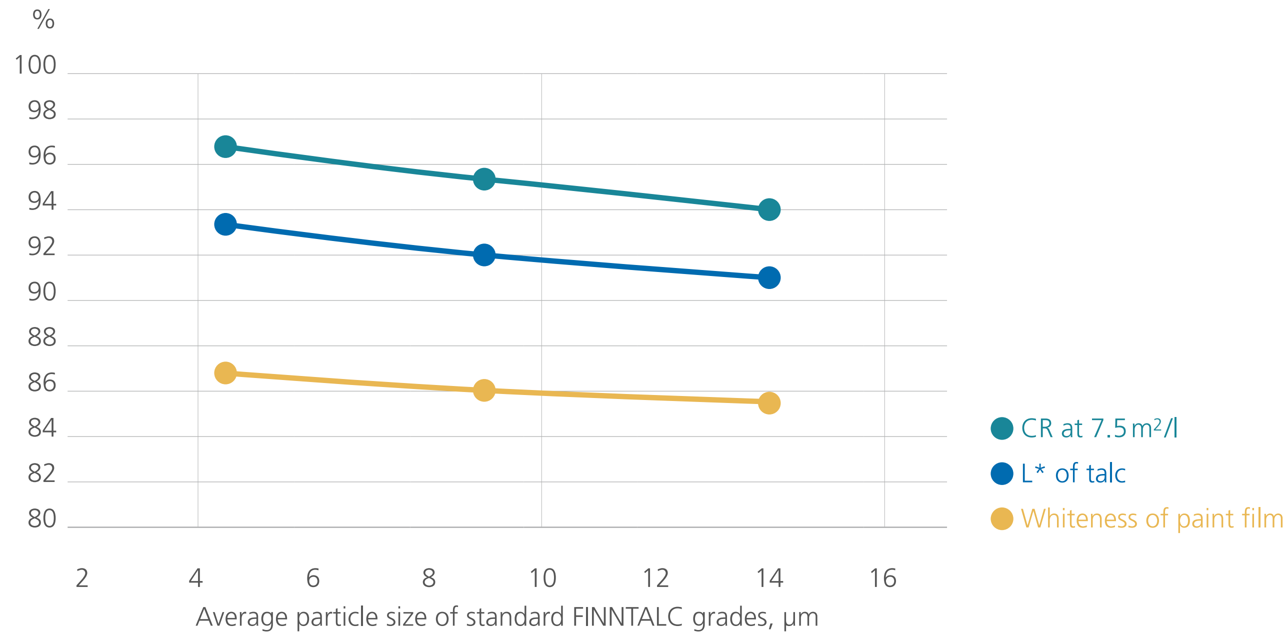

Figure 5: Optical properties of paint film and talc vs. the average particle size of talc. The grades used were FINNTALC standard grades.

MUD CRACKING

The tension that develops in the film-forming process is responsible for the occurrence of mud cracking in emulsion paint films. The film tension develops more or less spontaneously and can vary greatly. The complete elimination of cracking is only possible when an extender with a reinforcing effect such as one with a lamellar structure like macro-crystalline talc is used. The talc reduces the shrinkage of binders during drying and so reduces the film tension. The lower shrinkage improves the mud cracking resistance as well as adhesion to the substrate. So the lamellar particle form is the key to improving mud cracking resistance. This property is given as the maximum dry film thickness where no cracks develop. The effect of talc type on mud crack resistance is presented in the figure below.

FINNTALC M20SL that is very platy and pure resulted in the best mud cracking resistance. Micro-crystalline talc, which is less platy (lower aspect ratio) than macro-crystalline talcs, resulted in the lowest mud crack resistance.

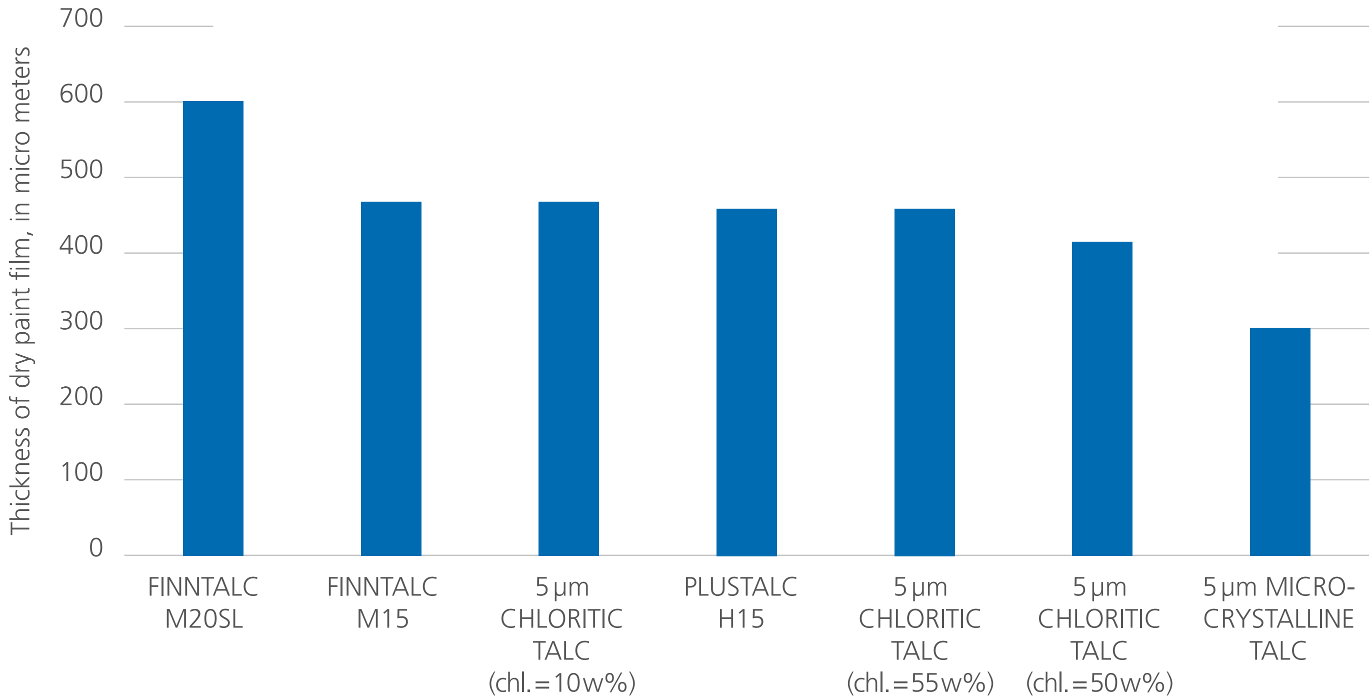

Figure 6: Effect of talc type on mud cracking resistance

SHEEN (GLOSS AT AN ANGLE OF 85°)

One important role of extenders in paints is gloss regulation. The coarser the extender, the lower the gloss; that is always the case. In this study, the paints were matt, so the sheen (gloss at 85° angle) was measured. Interior emulsion paints should exhibit as low a sheen as possible, because experience has shown that when this exceeds 5 %, the unevenness of the substrate, brush marks, etc. become visible due to irregularities in the gloss. The sheen value can be eliminated or at least reduced to a tolerable level by coarse lamellar extenders.

In Figure 7, the sheen values for different types of talc are given. The effect of the fineness of the talc on the sheen value is shown in Figure 8.

Figure 7 shows that gloss depends on the fines content of talc. The only exception to this can be seen in the two chlorite-rich talc grades, which have somewhat higher sheen values than would be expected from the fines contents.

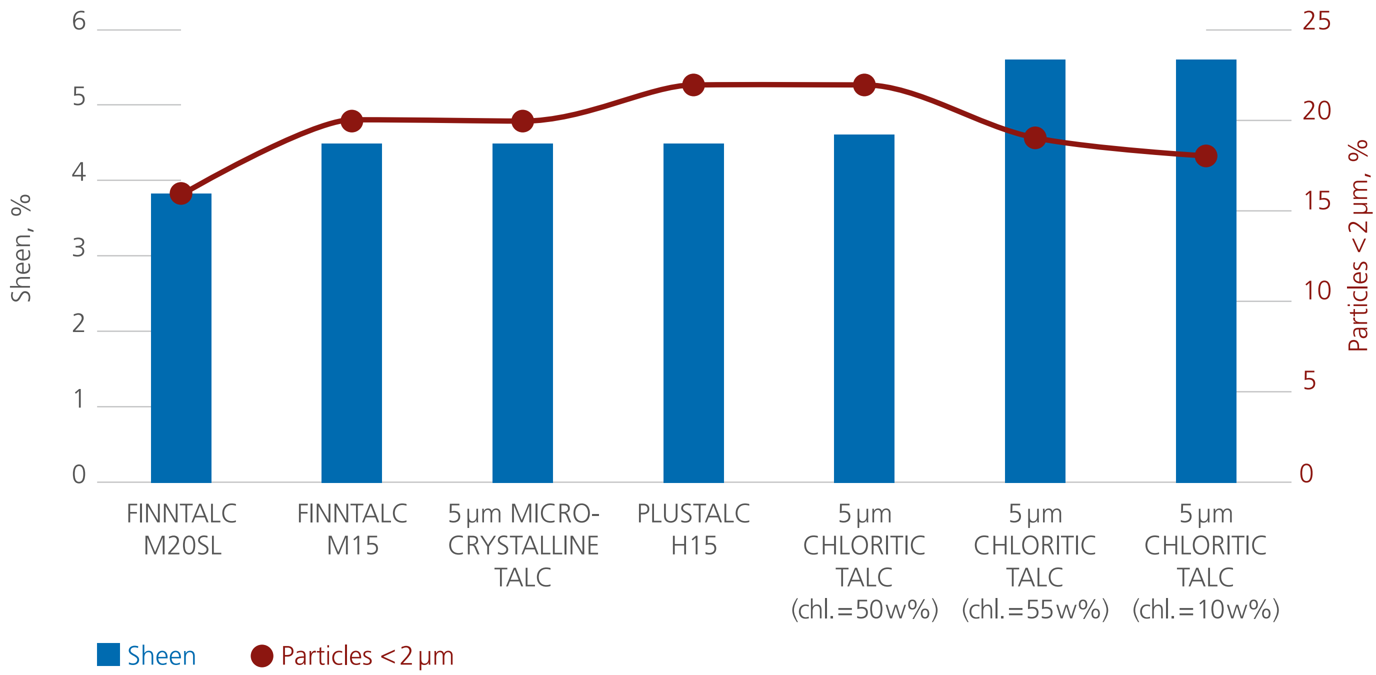

Figure 7: Gloss at 85° angle (sheen) for different types of talc at a PVC of 70 %. The amount of particles smaller than 2 µm is also given.

In Figure 8, the sheen values of talc grades with the same mineralogical base, but of different fineness, are shown at a PVC of 70 %. This illustrates clearly how very sensitive the gloss is to the fineness of the extender. When the fine fraction of the talc is reduced so is the gloss.

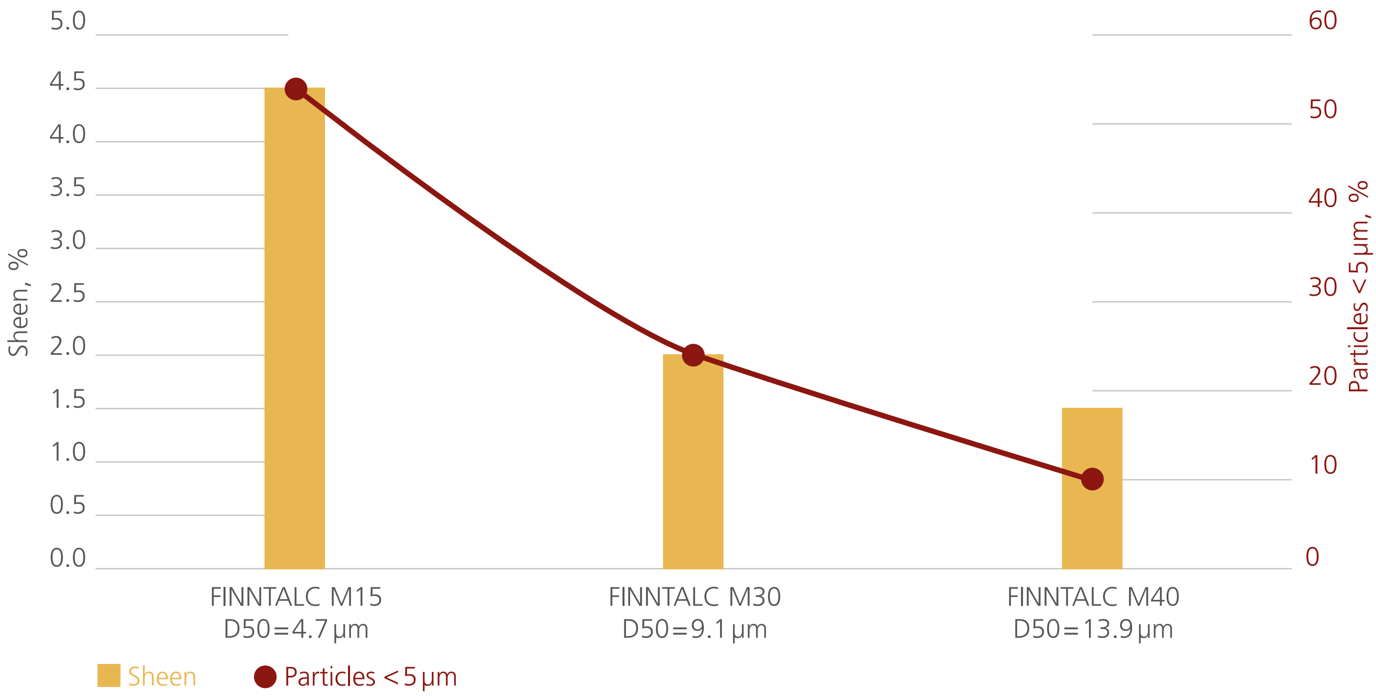

Figure 8: The sheen of FINNTALC grades with different fineness at a PVC of 70 %

VISCOSITY

Extenders also affect the applicational properties of paints. In this study, the viscosity of the paints was not adjusted; it varied with each of the talcs. Two different viscosity values were measured: Brookfield 100 rpm and 1 rpm. The higher shear rate viscosity indicates the applicational properties and the lower shear rate the stability and anti-sagging behaviour of the paint. The ideal viscosity profile would be a very low viscosity at a high shear rate and a very high viscosity at a low shear rate. The shear thinning index or pseudo-plasticity index (PSI) was calculated as follows:

PSI = Br1/Br100

The higher this ratio is, the better the stability and resistance to sagging. In addition, the applicational viscosity (Br100) should be as low as possible to give the most desirable viscosity profile.

Figure 9 shows the viscosity performance of different talc types.

As one can see from Figure 9, FINNTALC M20SL gave the best viscosity performance – the lowest applicational viscosity, but highest pseudo-plasticity index (Br1/B100). The micro-crystalline talc gave quite high viscosities, which was caused by the large content of small particles that are not platy. Micro-crystalline talc grinds very easily, which results in a high fines content. High fines content means a high surface area of solid particles and so higher viscosity. For platy talc, the true fines content cannot be seen from the particle size distribution curve determined using a SediGraph, because in this method the particle size is given as the diameter of round particles that sediment in water at the same rate as the particles measured. More platy particles precipitate more slowly, which means that the SediGraph method gives too high a fines content. So if two different talc grades are compared, one being more platy than the other, and they both have the same percentage of fines as determined using a SediGraph, the product that is less platy actually contains more fines than the more platy material.

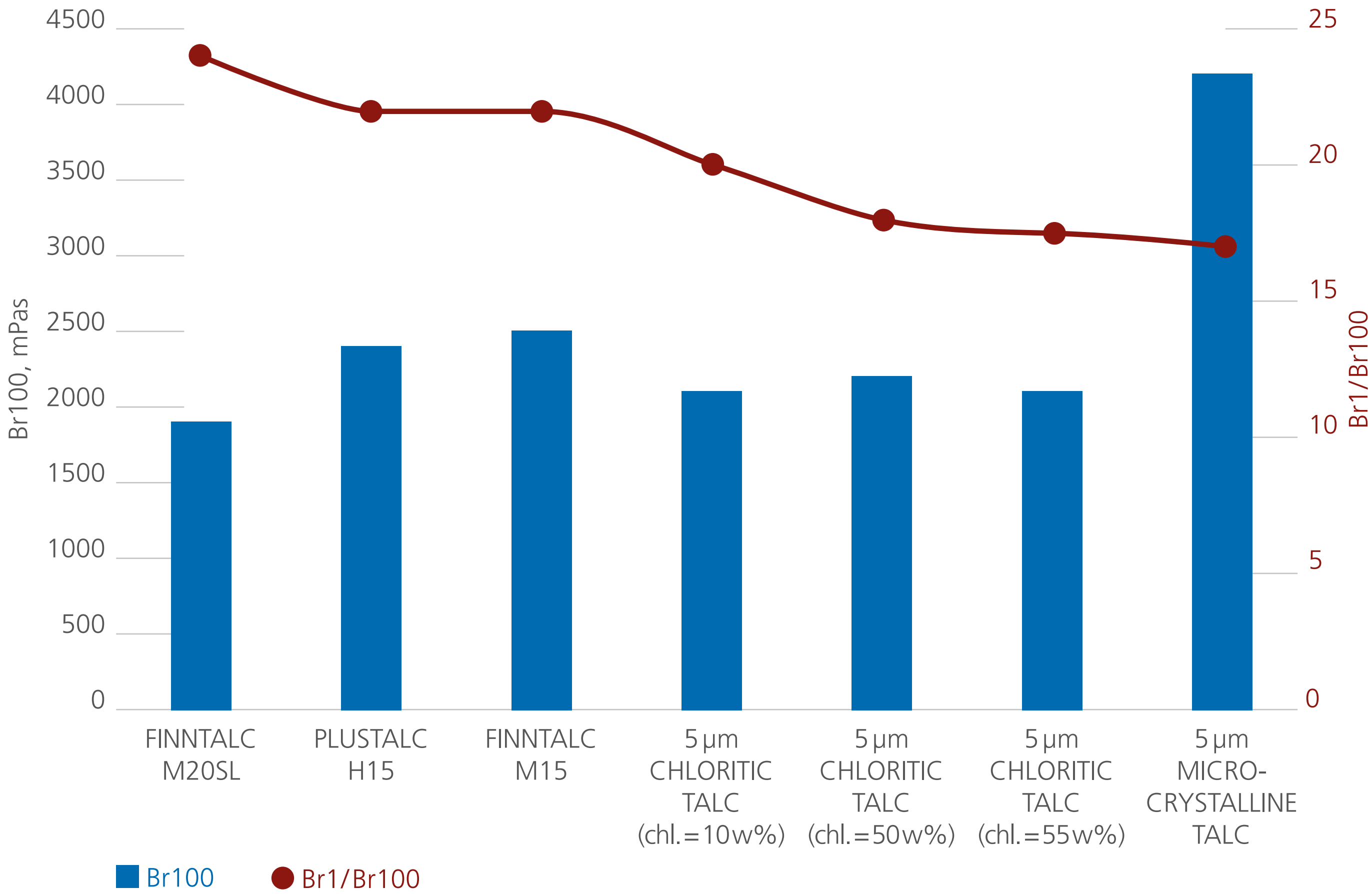

Figure 9: Viscosity performance of different talc grades in the paints at a PVC of 70 %

CONCLUSIONS

The effect of different talc types on the most important interior decorative paint properties was evaluated. The main interest was to see the impact of talc type on wet scrub resistance according to the ISO 11998 standard. The wet scrub resistance is a very important property because it is used as a classification criterion for interior and ceiling paints (EN 13300).

The pure, platy and flotated FINNTALC grades, FINNTALC M15 and M20SL, gave the best overall performance results. Paints containing them showed excellent wet scrub resistance. The paints containing the FINNTALC grades complied with wet scrub class 2 according to the classification of EN 13300. When the paint formulation contained impure talc grades, (chlorite-rich talc), the classification dropped to class 3. The particle size of the talc affected the WSR somewhat – the coarser the product, the better the WSR.

FINNTALC grades also had the best combination of optical properties, which means that they had the highest hiding power and paint film whiteness at sheen values below 5. The pure macro-crystalline FINNTALC grades had the viscosity profile that is normally desired for decorative paints – easy to apply, but no sagging or sedimentation of solid particles.

The performance of different type of talcs tested can be summarised as follows:

	PURE, MACRO-CRYSTALLINE	MICRO-CRYSTALLINE	CHLORITE-CONTAINING
WET SCRUB RESISTANCE	++	+	–
MUD CRACKING RESISTANCE	++	+	++
ANTI-SETTLING	++	0	++
MATTING	++	+	++
OPACITY	+	+	+
WHITENESS	+	+	+

++ big positive impact + small positive impact 0 no effect – negative impact

APPENDIX 1

PROPERTY	UNIT	FINNTALC M15	FINNTALC M20SL	PLUSTALC H15	5 µm MICRO-CRYSTAL-LINE TALC	5 µm CHLORITIC TALC (50 % chlorite)	5 µm CHLORITIC TALC (55 % chlorite)	5 µm CHLORITIC TALC (10 % chlorite)
LOSS ON IGNITION	w%	5.8	5.1	5.4	5.7	8.3	8.7	6.8
HCl SOLUBLES	w%	3.8	1.4	2.5	5.3	6.4	5.5	4.7
ISO BRIGHTNESS	%	83.1	86.5	93.2	85.2	80.9	75.5	85.9
RY WHITENESS	%	84.1	87.5	96.5	87.7	81.8	76.2	86.8
					3.71			
CIE VALUES, L*		93.5	95.0	97.4	95.0	92.5	89.9	94.6
a*		-0.24	-0.37	-0.12	0.11	-0.29	-0.29	-0.20
b*		0.92	0.85	0.29	1.86	0.75	0.62	0.66
HEGMAN FINENESS	µm	51	62	50	44	40	42	36
BULK DENSITY	kg/m³	410	400	430	444	484	490	440
TAPPED DENSITY	kg/m³	540	500	580	597	672	650	598
OIL ABSORPTION	g/100 g	43	38	37	32	29	34	30
SPECIFIC SURFACE AREA (BET)	m²/g	5.8	5.0	5.7	8.5	4.1	4.7	4.6
PSD BY SEDIGRAPH								
< 30 µm	w%	100	100	100	100	100	100	100
< 20 µm	w%	99	98	97	97	98	98	99
< 10 µm	w%	89	82	81	76	83	86	89
< 5 µm	w%	54	46	48	46	48	54	52
< 2 µm	w%	20	16	22	20	18	22	19
< 1 µm	w%	11	5	9	12	10	11	10
D50	µm	4.7	5.4	5.2	5.5	5.2	4.6	4.8

Table 1.1: Properties of medium-fine talc grades

APPENDIX 2

PROPERTY	UNIT	FINNTALC M30	FINNTALC M30SL	FINNTALC M40	10 µm CHLORITIC TALC (10 % chlorite)	7 µm CHLORITIC TALC (50 % chlorite)	7,5 µm CHLORITIC TALC (55 % chlorite)
LOSS ON IGNITION	w%	5.8	5.1	5.9	5.2	9.6	9.0
HCl SOLUBLES	w%	3.1	1.7	2.9	1.3	6.7	7.9
ISO BRIGHTNESS	%	79.5	85.8	77.8	88.1	83.9	81.7
RY WHITENESS	%	81.1	87.3	78.8	89	86.1	83.3
CIE VALUES, L*		92.17	94.86	91.14	95.55	94.32	93.12
a*		-0.36	-0.54	-0.22	-0.10	-0.49	-0.43
b*		1.45	1.32	1.02	0.61	1.83	1.41
HEGMAN FINENESS	µm	120	90	125	80	77	80
BULK DENSITY	kg/m^3	590	600	740	544	536	584
TAPPED DENSITY	kg/m^3	870	910	930	872	867	869
OIL ABSORPTION	g/100 g	29	38	26	20	26	26
SPECIFIC SURFACE AREA (BET)	m^2/g	2.7	3.9	2.5	2.1	2.9	2.9
PSD BY SEDIGRAPH							
< 40 µm	w%	98	100	97	100	100	100
< 30 µm	w%	94	95	91	97	97	97
< 20 µm	w%	84	85	74	84	88	88
< 10 µm	w%	55	50	29	49	62	62
< 5 µm	w%	23	23	10	22	37	35
< 2 µm	w%	7	10	6	10	14	13
< 1 µm	w%	4	3	3	6	4	3
D50	µm	9.1	9.9	13.9	10.2	7.3	7.6

Table 1.2: Properties of coarse talc grades

APPENDIX 3

PROPERTY	UNIT	FINNTALC M15	FINNTALC M20SL	PLUSTALC H15	5 µm MICRO-CRYSTAL-LINE TALC	5 µm CHLORITIC TALC (10 % chlorite)	5 µm CHLORITIC TALC (50 % chlorite)	5 µm CHLORITIC TALC (55 % chlorite)
BR VISCOSITY (100 RPM)	mPas	2,500	1,900	2,400	4,200	2,100	2,200	2,100
BR VISCOSITY (50 RPM)	mPas	3,700	3,000	3,600	5,900	3,100	3,300	3,100
BR VISCOSITY (20 RPM)	mPas	6,600	5,200	6,400	10,000	5,400	5,400	5,200
BR VISCOSITY (1 RPM)	mPas	54,800	45,200	53,200	69,600	43,600	39,600	37,200
CONTRAST RATIO, WET FILM THICKNESS OF 150 µm	%	95.8	95.2	94.7	95.1	95.9	96.4	97.6
CONTRAST RATIO, SPREADING RATE 7.5 m^2/l	%	96.7	96.0	95.8	95.5	96.3	97.0	97.9
WHITENESS OF PAINT FILM	%	86.5	88.0	90.2	88.8	88.4	86.3	83.2
CIE VALUES, L*		94.52	95.17	96.07	95.44	95.33	94.45	93.11
a*		-0.54	-0.55	-0.50	-0.39	-0.52	-0.55	-0.56
b*		1.86	2.13	2.04	2.56	1.89	1.72	1.37
GLOSS 60°	%	2.4	2.4	2.5	2.4	2.6	2.5	2.5
GLOSS 85°	%	4.5	3.8	4.7	4.6	5.5	5.1	5.4
MUD CRACKING RESISTANCE, DRY FILM THICKNESS	µm	480	600	470	300	480	420	470
WET SCRUB RESIS-TANCE ISO 11998 (drying=3 days at 50 °C and 1 day at 23 °C and 50 % RHO, 200 cycles)	µm	17	17	20	19	25	27	29

Table 2.1: Paint results for medium-fine talc grades

APPENDIX 4

PAINT PROPERTIES	UNIT	FINNTALC M30	FINNTALC M30SL	FINNTALC M40	10 µm CHLORITIC TALC (10 % chlorite)	7 µm CHLORITIC TALC (50 % chlorite)	7,5 µm CHLORITIC TALC (50 % chlorite)
BR VISCOSITY (100 RPM)	mPas	2,900	2,600	3,100	2,700	2,500	2,200
BR VISCOSITY (50 RPM)	mPas	4,200	3,900	4600	3,900	3,700	3,200
BR VISCOSITY (20 RPM)	mPas	7,200	6,700	7,700	6,700	6,200	5,400
BR VISCOSITY (1 RPM)	mPas	54,800	53,600	55,200	49,600	42,000	36,800
CONTRAST RATIO, WET FILM THICKNESS OF 150 µm	%	95.3	93.4	93.2	93.7	95.1	95.3
CONTRAST RATIO, SPREADING RATE 7.5 m²/l	%	94.7	94.5	93.8	94.3	95.3	95.6
WHITENESS OF PAINT FILM	%	86.0	88.3	85.4	88.8	88.7	87.5
CIE VALUES, L*		94.32	95.26	94.07	95.48	95.46	94.96
a*		-0.57	-0.60	-0.56	-0.53	-0.56	-0.53
b*		2.10	2.26	1.94	2.09	2.16	2.05
GLOSS 60°	%	2.3	2.4	2.2	2.4	2.5	2.5
GLOSS 85°	%	1.9	2.1	1.3	2.3	3.0	2.9
MUD CRACKING RESISTANCE, DRY FILM THICKNESS	µm	510	570	470	540	590	490
WET SCRUB RESISTANCE ISO 11998 (drying = 28 days at 23 °C and 50 % RHU, 200 scrub cycles)	µm	16	16	12	20	25	22

Table 2.2: Paint results for coarse talc grades

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