EVONIK INDUSTRIES

SIPERNAT® 820 A
for emulsion and decorative paints

Technical Bulletin 34

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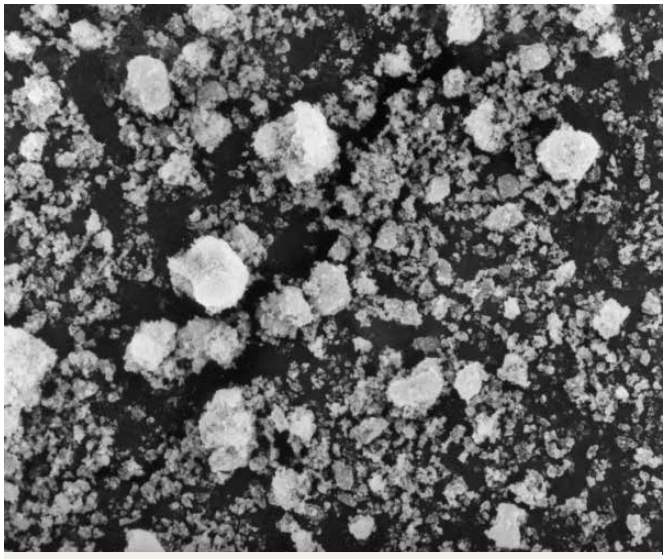
1 SIPERNAT® 820 A

Over the past few decades the filler SIPERNAT® 820 A has been used successful in the paint and lacquer industry. SIPERNAT® 820 A is employed as a partial replacement for titanium dioxide. In general quantities of 2–5 % by weight SIPERNAT® 820 A related to the total formulation has been proven successful in emulsion as well as in decorative paints.

In addition to commercial advantages, coating characteristics can be developed with this filler, which can not be attained with natural products.

SIPERNAT® 820 A is produced by a special precipitation and drying process. It is a sodium aluminium silicate. The conglomeration of the primary particles results in the formation of aggregates and due to the interaction of the aggregates in the formation of agglomerates (see DIN 53 206).

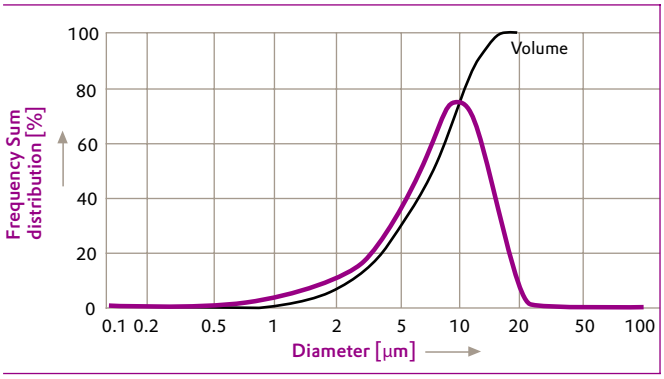
Figure 1
Scanning electron micrograph of SIPERNAT® 820 A



Enlargement: 1,000:1

Figure 2 shows the particle size distribution curve of the agglomerates of SIPERNAT® 820 A. In this figure the percentual amount of the agglomerates is plotted versus the logarithm of the particle size. The agglomerates have an average particle size (d50) of approx. 7 µm (Laser diffraction).

Figure 2
Particle size distribution of SIPERNAT® 820 A



The closely controlled synthetic production process of SIPERNAT® 820 A results in a fine particle size with high intensity whiteness. These characteristics provide superior coating performance in emulsion and decorative paints when compared with naturally occurring extenders, even purified versions.

The standard value Y of SIPERNAT® 820 A is approx. 97 %, the refractive index 1.46.

Figure 3
Facade of a duplex house after a period of eight years
Duplex house left: Paint without SIPERNAT® 820 A
Duplex house right: Paint with 5 % SIPERNAT® 820 A

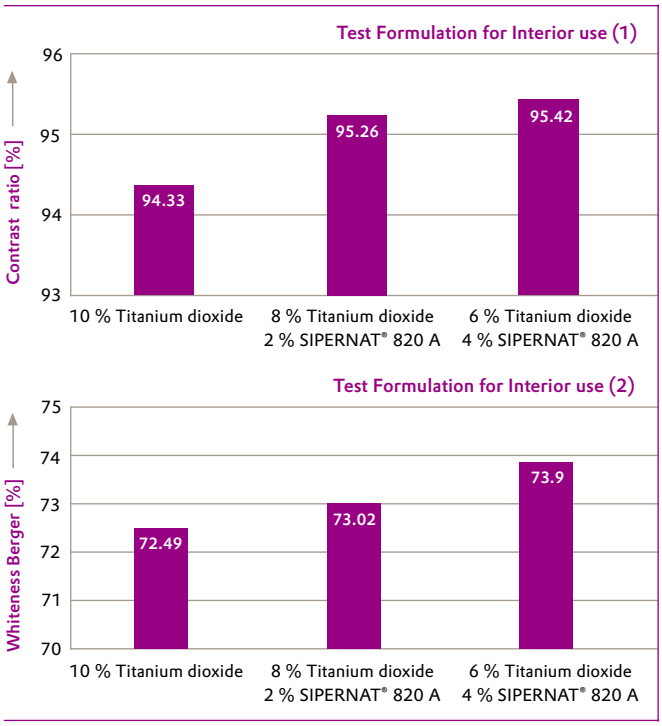
2 Coating application information

2.1 SIPERNAT® 820 A in emulsion paints

In emulsion paint, it is possible to substitute the titanium dioxide with SIPERNAT® 820 A, by up to 40% by weight, depending on the type of titanium dioxide used and its percentual portion in the formulation.

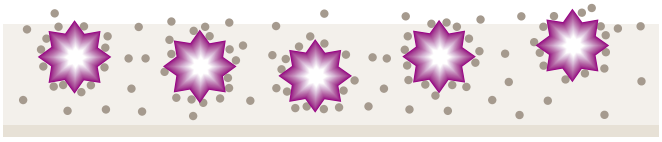
Related to the total formulation, the proportion of SIPERNAT® 820 A should not exceed 2–5 % by weight. Through this substitution, in most cases, the opacity of the dry paint is increased. The degree of whiteness is increased in any case. **Figures 4–5** demonstrate the contrast ratio and the degree of whiteness of a paint for interior use after the replacement of 2 respectively 4 % titanium dioxide by SIPERNAT® 820 A.

Figure 4–5
Contrast ratio of a paint for interior use after the replacement of 2 respectively 4 % titanium dioxide by SIPERNAT® 820 A



In addition to the improvement in the visual characteristics of emulsion paint, a distinct saving in costs will be achieved by using SIPERNAT® 820 A as the filler is highest possible arranged between the dispersed particles of titanium dioxide.

Figure 6
Increased hiding power and higher degree of whiteness achieved by the spacer effect of spacer effect of SIPERNAT® 820 A



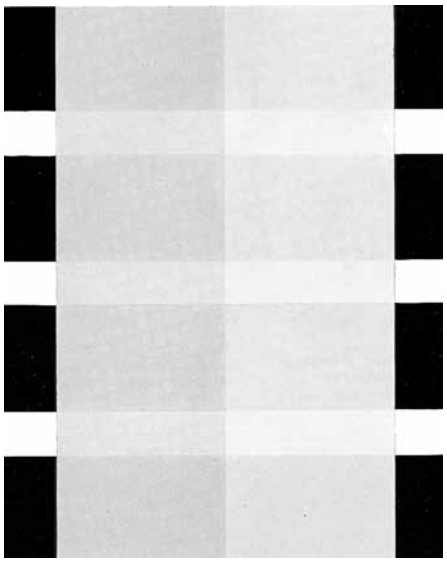
● Titanium dioxide [0.3 µm] ✿ SIPERNAT® 820 A

Therewith SIPERNAT® 820 A causes a maximizing of the white pigment titanium dioxide on paint surface through which hiding power and whiteness of the formulation will be improved.

The hiding power is the ability of a dispersion coating to mask large differences in colour and lightness in the substrate. The hiding power should be as high as possible in order to achieve this even at low coat thickness. The extent of the covering power can be determined by the contrast ratio, comparing the lightness of a white paint on a black and a white substrate.

Figure 7 illustrates by means of a contrast card the increased hiding power of SIPERNAT® 820 A containing emulsion paint.

Figure 7
Hiding power of two interior emulsion paints. Right side with, left side without SIPERNAT® 820 A

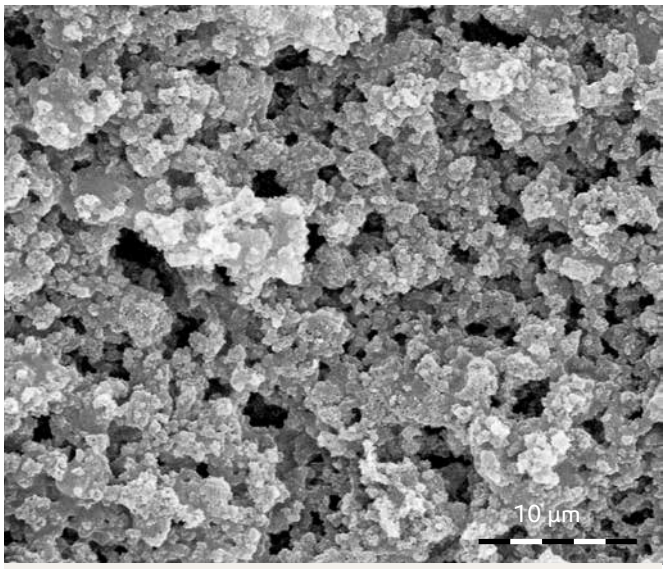


Even in combination with aftertreated titanium dioxide with high portions of aluminium or silicon compounds, in some cases whiteness and hiding power can be further increased by SIPERNAT® 820 A. During the precipitation process, fine X-ray amorphous silicate primary particles are formed, which associate with other particles to form aggregates and agglomerates.

During this process a large number of interstitial cavities are formed. The higher the number of interstitial cavities, the larger is the pore volume and the higher is the dry hiding power of the finished paint.

Figure 8 shows the REM micrograph of the pore structure of SIPERNAT® 820 A in a coating consisting out of water, binder and SIPERNAT® 820 A.

Figure 8
Pore structure of SIPERNAT® 820 A



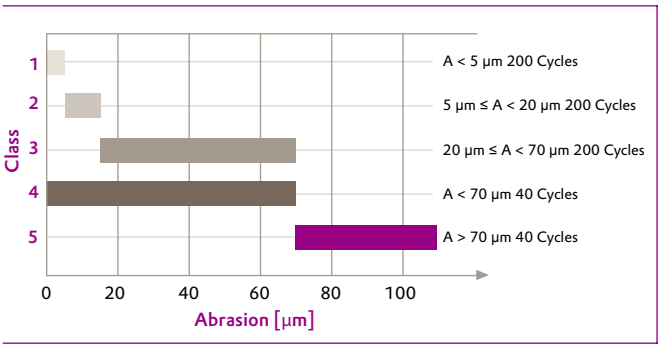
Enlargement: 3,000:1

The porosity of the paint brought by SIPERNAT® 820 A also has the effect that air becomes entrapped in the film, which has a lower refractive index than the water that is present before drying. Compared to the surroundings, the refractive index of the individual components (pigment, filler and binder) are higher than before the drying, due to the water/air exchange. If the difference of the two refractive indices is large enough, the light will be largely reflected and the coating appears white and shows a greater hiding power. This phenomenon is also known as dry hiding-effect.

However SIPERNAT® 820 A is not a pigment (refractive index n > 1.70). This can be clearly seen by comparing the refractive indices of titanium dioxide (n = 2.70) and SIPERNAT® 820 A (n = 1.46).

On account of its porosity and the extreme particle fineness, SIPERNAT® 820 A is characterised by a high oil absorption, which in turn reduces the critical pigment volume concentration of the formulation. The high oil absorption of the synthetic aluminium silicates is not necessarily detrimental to the mechanical properties of an emulsion-paint. Especially in combination with coarse-particle fillers SIPERNAT® 820 A allows efficient matting while preserving the optical and mechanical properties of the paint. Due to the replacement of the white titanium dioxide, PVC is increased by only 1–2 %, which does not have an adverse effect with the paints produced according to the listed test formulations. SIPERNAT® 820 A has a favourable influence on the brushability and the levelling of emulsion paints. To which extend an emulsion paint can be classified as scrub resistant (class 1 and 2) or wash resistant (class = 3) is defined by the determination of wet abrasion resistance in accordance with DIN ISO 11998. The wet abrasion resistance assesses the stability of the coating against repetitive cleaning. In addition the qualitative classification of the emulsion paints is carried out according to DIN EN 13300 (**Figure 9**).

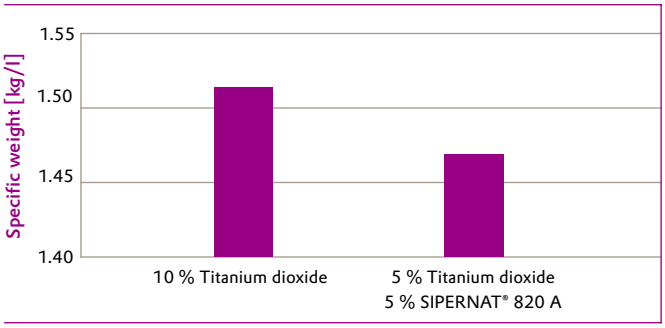
Figure 9
Determination of the wet abrasion resistance – classification according to DIN EN 13300 abrasion (A) [µm]



To ensure that producer and applicator of these paints are discussing on the same basis the criterias are fixed in the European Standard. SIPERNAT® 820 A has a comparative low specific density. This effects an increase of volume of the finished paint and gives a further interesting viewpoint.

Figure 10 shows the specific weight on an emulsion paint based on 10 % titanium dioxide in comparison to a formulation, in which 5 % of the titanium dioxide is replaced by SIPERNAT® 820 A.

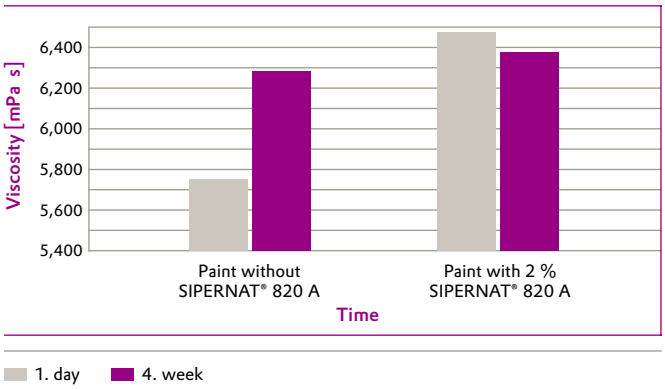
Figure 10
Reduction of the specific weight by using SIPERNAT® 820 A



Even after an extended storage time the viscosity behaviour of emulsion paints containing SIPERNAT® 820 A remains good. In most cases, the use of SIPERNAT® 820 A in emulsion paints results in an increased viscosity, but this rule does not apply generally to all formulations with SIPERNAT® 820 A.

Figure 11 demonstrates the viscosity behaviour of two emulsion paints after a 4 week storage test at + 40 °C.

Figure 11
Viscosity behaviour of emulsion paints – storage test:
4 weeks at T = + 40 °C



At the beginning the emulsion paint which contains SIPERNAT® 820 A shows a little bit higher viscosity which remains stable even after a longer storage time. Compared to the paint formulated merely with titanium dioxide the latter shows a slight viscosity increase.

The pH value of 5 % aqueous SIPERNAT® 820 A suspension is about 10.1, thus the pH-value in emulsion paint usually increases. The shift into the more strongly basic range has a positive effect on the storage stability.

2.1.1 Paints for Interior use – Guide Formulations

Formulation 1

Emulsion paint for **interior use**		1	2	3
1	Water	30.2	30.2	30.2
2	Walocel XM 20000 PV	0.3	0.3	0.3
3	Calgon N	0.7	0.7	0.7
4	Lopon 890	0.2	0.2	0.2
5	Agitan 280	0.4	0.4	0.4
6	Acticide MBS	0.1	0.1	0.1
7	SIPERNAT® 820 A	0	2	4
8	Kronos® 2190	10	8	6
9	Luzenac OOC	7	7	7
10	Talkum Naintsch ASE 10	3	3	3
11	Omyacarb 5 GU	25	25	25
12	Omyalite 90	7	7	7
13	Acrysol RM 8	0.1	0.1	0.1
14	Mowilith LDM 1871	16	16	16
	Total	100	100	100
	PVC	69.27	69.81	70.34

2 Walocel XM 20000 PV: Dow Wolff Cellulosics GmbH, 29699 Bomlitz, Germany
3 Calgon N: BK Giulini Chemie GmbH & Co. OHG, 68526 Ladenburg, Germany
4 Lopon 890: BK Giulini Chemie GmbH & Co. OHG, 68526 Ladenburg, Germany
5 Agitan 280: Münzing Chemie GmbH, 74076 Heilbronn, Germany
6 Acticide MBS: Thor Chemie GmbH, 67346 Speyer, Germany
7 SIPERNAT® 820 A: Evonik Industries AG, 45128 Essen, Germany
8 Kronos® 2190: KRONOS INTERNATIONAL, INC., 51307 Leverkusen, Germany
9 Luzenac OOC: Imerys Talc Germany GmbH, 40210 Düsseldorf, Germany
10 Talkum Naintsch ASE: Imerys Talc Germany GmbH, 40210 Düsseldorf, Germany
11 Omyacarb 5 GU: Omya GmbH, 50679 Köln, Germany
12 Omyalite 90: Omya GmbH, 50679 Köln, Germany
13 Acrysol RM 8: Rohm and Haas Europe Trading ApS, 60461 Frankfurt am Main, Germany
14 Mowilith LDM 1871: Celanese Chemicals Europe GmbH, 65843 Sulzbach (Taunus), Germany

Formulation 2

Emulsion paint for **interior use**		1	2	3
1	Water	28.2	28.2	28.2
2	Natrosol 250 MBR	0.35	0.35	0.35
3	Calgon N (10%)	0.6	0.6	0.6
4	AMP 90	0.1	0.1	0.1
5	Lopon 895 (40%)	0.35	0.35	0.35
6	Agitan 315	0.2	0.2	0.2
7	Mergal K 12 N	0.1	0.1	0.1
8	SIPERNAT® 820 A	0	2	4
9	Kronos® 2190	10	8	6
10	Luzenac OOC	7	7	7
11	Omyacarb 2 GU	12.5	12.5	12.5
12	Omyacarb 5 GU	20	20	20
13	Omyalite 90	10	10	10
14	Acrysol RM 8 W (35%)	0.1	0.1	0.1
15	Mowilith LDM 1871	10.5	10.5	10.5
	Total	100	100	100
	PVC	79.87	80.59	81.25

2 Natrosol 250 MBR: Ashland Industries Deutschland GmbH, 40599 Düsseldorf, Germany
3 Calgon N: BK Giulini Chemie GmbH & Co. OHG, 68526 Ladenburg, Germany
4 AMP 90: Angus Chemie GmbH, 49479 Ibbenbüren, Germany
5 Lopon 895: BK Giulini Chemie GmbH & Co. OHG, 68526 Ladenburg, Germany
6 Agitan 315: Münzing Chemie GmbH, 74076 Heilbronn, Germany
7 Mergal K 12 N: Troy Chemie GmbH, 30173 Hannover, Germany
8 SIPERNAT® 820 A: Evonik Industries AG, 45128 Essen, Germany
9 Kronos® 2160: KRONOS INTERNATIONAL, INC., 51307 Leverkusen, Germany
10 Luzenac OOC: Imerys Talc Germany GmbH, 40210 Düsseldorf, Germany
11 Omyacarb 2 GU: Omya GmbH, 50679 Köln, Germany
12 Omyacarb 5 GU: Omya GmbH, 50679 Köln, Germany
13 Omyalite 90: Omya GmbH, 50679 Köln, Germany
14 Acrysol RM 8: Rohm and Haas Europe Trading ApS, 60461 Frankfurt am Main, Germany
15 Mowilith LDM 1871: Celanese Chemicals Europe GmbH, 65843 Sulzbach (Taunus), Germany

2.1.2 Paints for Exterior use – Guide Formulations

Formulation 1

	Emulsion paint for **exterior use**	1	2	3
1	Water	16.5	16.5	16.5
2	Pigmentverteiler A	0.3	0.3	0.3
3	Calgon N (25 %)	0.4	0.4	0.4
4	Ammonia conc.	0.2	0.2	0.2
5	Acticide MBS	0.3	0.3	0.3
6	Walocel XM 20000 PV (25 %)	0.2	0.2	0.2
7	White spirit K 30	1.3	1.3	1.3
8	Texanol	0.7	0.7	0.7
9	Lumiten N-OC 30	0.8	0.8	0.8
10	Kronos® 2059	18	16	14
11	Omyacarb 5 GU	24	24	24
12	Talkum Naintsch ASE 10	5	5	5
13	SIPERNAT® 820 A	0	2	4
14	Agitan 280	0.3	0.3	0.3
15	Acronal 290 D	32	32	32
	Total	100	100	100
	PVC	49.47	51.05	52.13

Formulation 2

	Emulsion paint for **exterior use**	1	2	3
1	Water	7	7	7
2	Tylose MH 4000	10	10	10
3	Calgon N	1.5	1.5	1.5
4	Pigment disperser A	0.3	0.3	0.3
5	Agitan 315	0.4	0.4	0.4
6	Acticide MBS	0.1	0.1	0.1
7	AMP 90	0.1	0.1	0.1
8	SIPERNAT® 820 A	0	2	4
9	Kronos® 2190	20	18	16
10	Finntalc M05N	5	5	5
11	Omyacarb 5 GU	22	22	22
12	Diethylene glycol acetate	0.7	0.7	0.7
13	Dowanol DPnB	0.9	0.9	0.9
14	Mowilith LDM 2110	32	32	32
	Total	100	100	100
	PVC	49.05	49.80	50.55

2 Pigment disperser A: BASF SE, 67056 Ludwigshafen, Germany
3 Calgon N: BK Giulini Chemie GmbH & Co. OHG, 68526 Ladenburg, Germany
5 Acticide AS N: Thor Chemie GmbH, 67346 Speyer, Germany
6 Walocel XM 20000 PV: Dow Wolff Cellulosics GmbH, 29699 Bomlitz, Germany
7 White spirit: Deutsche Shell Chemie GmbH, 65706 Eschborn, Germany
8 Texanol: KRAHN CHEMIE GmbH, 20457 Hamburg, Germany
9 Lumiten N-OC 30: BASF SE, 67056 Ludwigshafen, Germany
10 Kronos® 2059: KRONOS INTERNATIONAL, INC., 51307 Leverkusen, Germany
11 Omyacarb 5 GU: Omya GmbH, 50679 Köln, Germany
12 Talkum Naintsch ASE: Imyers Talc Germany GmbH, 40210 Düsseldorf, Germany
13 SIPERNAT® 820 A: Evonik Industries AG, 45128 Essen, Germany
14 Agitan 280: Münzing Chemie GmbH, 74076 Heilbronn, Germany
15 Acronal 290 D: BASF SE, 67056 Ludwigshafen, Germany

2 Tylose MH 4000: SE Tylose GmbH & Co. KG, 65203 Wiesbaden, Germany
3 Calgon N: BK Giulini Chemie GmbH & Co. OHG, 68526 Ladenburg, Germany
4 Pigment disperser A: BASF SE, 67056 Ludwigshafen, Germany
5 Agitan 315: Münzing Chemie GmbH, 74076 Heilbronn, Germany
6 Acticide AS N: Thor Chemie GmbH, 67346 Speyer, Germany
7 AMP 90: Angus Chemie GmbH, 49479 Ibbenbüren, Germany
8 SIPERNAT® 820 A: Evonik Industries AG, 45128 Essen, Germany
9 Kronos® 2190: KRONOS INTERNATIONAL, INC., 51307 Leverkusen, Germany
10 Finntalc M05N: Mondo Minerals Deutschland GmbH, 63628 Bad Soden-Salmünster, Germany
11 Omyacarb 5 GU: Omya GmbH, 50679 Köln, Germany
13 Dowanol DPnB: Dow Deutschland GmbH & Co. OHG, 65824 Schwalbach, Germany
14 Mowilith LDM 2110: Celanese Chemicals Europe GmbH, 65843 Sulzbach (Taunus), Germany

2.2 SIPERNAT® 820 A in decorative paints

In addition to its use in emulsion paints, SIPERNAT® 820 A has also gained importance in decorative paints.

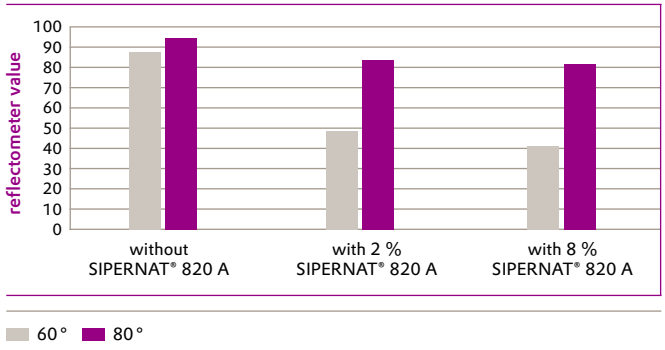
By using of SIPERNAT® 820 A effects can be developed in decorative paints which can not be attained with natural products, even if these have been milled extremely fine. Especially in flat or satin gloss systems and primers it is possible to replace a part of the white pigments without loss of hiding power.

Undercoats containing SIPERNAT® 820 A have a good hiding and filling power. They show faster surface-drying, a better through-drying and stand up to abrasive treatment. Undercoats with SIPERNAT® 820 A level out well and represent an excellent substrate for high gloss finishes.

In undercoats and decorative paints, SIPERNAT® 820 A acts as an antisettling agent for fillers and pigments. Additionally a slight degree of thixotropy is developed, which has a favourable effect on the brushability and prevents the paint from running off from vertical surfaces.

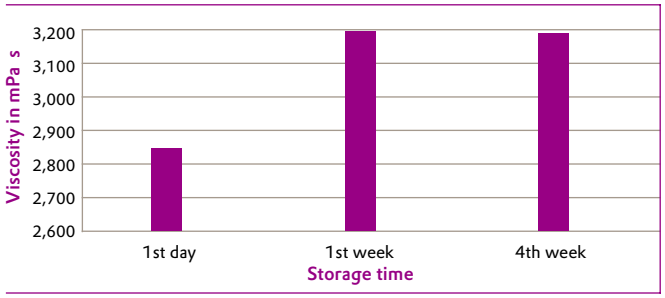
In satin gloss paints SIPERNAT® 820 A is used primarily as an economical flatting agent. In this special case the amount of SIPERNAT® 820 A can be as high as 10 % because the used binders have a high pigment absorption capacity. The mar- and wiping resistance of decorative paints is influenced positively in formulations with SIPERNAT® 820 A.

Figure 12
Matting effect of SIPERNAT® 820 A in decorative paints



SIPERNAT® 820 A is incorporated together with the pigments and fillers under the same dispersion conditions. As shown in **Figure 10**, the viscosity of decorative paints with SIPERNAT® 820 A is highly constant.

Figure 13
Viscosity of a decorative paint as a function of the storage time, storage time 4 weeks ati T = 40 °C



When selecting the binders for production of satin gloss decorative paints it must be ensured that they are compatible with basic pigments because of the high pH value of SIPERNAT® 820 A.

2.2.1. Guide formulation for a satin gloss decorative paint

Decorative paint (satin gloss)

	Position	% by weight
1	Synolac AS 631, 60 % in white spirit	59.6
2	White spirit K30/K60 2:1	10.1
3	Kronos® 2190	20.0
4	SIPERNAT® 820 A	5.0
5	Baysilone coating additive OL 17, 1 % in xylene	0.8
6	Octa-Soligen Co 6 %	0.3
7	Octa-Soligen Zr 6 %	1.4
8	Octa-Soligen Ca 10 %	0.4
9	Exkin 2	0.7
10	Bentone 34, paste 10 %	1.7
	Total	100.0

1 Cray Valley Kunstharze GmbH, 08056 Zwickau, Germany
2 Deutsche Shell Chemie GmbH, 65706 Eschborn, Germany
3 KRONOS INTERNATIONAL, INC., 51307 Leverkusen, Germany
4 Evonik Industries AG, 45128 Essen, Germany
5 OMG Borchers GmbH, 40764 Langenfeld, Germany
6 OMG Borchers GmbH, 40764 Langenfeld, Germany
7 OMG Borchers GmbH, 40764 Langenfeld, Germany
8 OMG Borchers GmbH, 40764 Langenfeld, Germany
9 Rockwood Pigments, Durham, UK DH3 1QX, UK
10 Nordmann, Rassmann GmbH, 20459 Hamburg, Germany

3 Physiochemical data of SIPERNAT® 820 A*

Properties and test methods	Unit	Value
Specific surface area (N_2) Multipoint following ISO 9277	m^2/g	**95**
DOA Absorption[1,4]	ml/100 g	**165**
Particle size, d_{50} Laser diffraction following ISO 13320-1	µm	**7.0**
Loss on drying 2 h at 105 °C following ISO 787-2	%	**≤ 7.0**
pH value 5 % in water following ISO 787-9	–	**10.1**
Sieve residue 45 µm spray following ISO 3262-19	%	**≤ 0.2**
Tamped density not sieved following ISO 787-11	g/l	**240**
Standard value Y following DIN 53163	–	**≥ 95**
Loss on ignition[2] 2 h at 1000°C following ISO 3262-1	%	**8.5**
SiO_2 content[3] following ISO 3262-19	%	**≥ 81**
Na content[3,4]	%	**5.0**
Al content[3,4]	%	**6.5**
Fe content[3,4]	ppm	**≤ 400**
Sulfate content[1,4]	%	**≤ 1.0**
Package size (net)	kg	**25**

[1] based on original substance
[2] based on dry substance (2 h / 105 °C)
[3] based on ignited substance (2 h / 1000 °C)
[4] internal method
* The given data are typical values. Specifications on request.

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