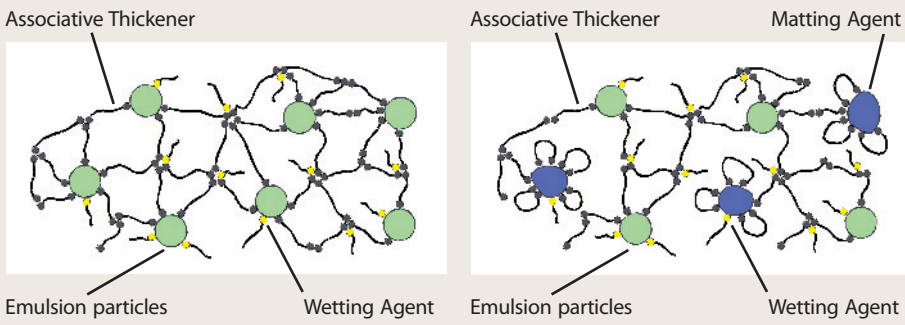
Novel Matting Agents for Waterborne Coatings

Since 1950, synthetic silica based on precipitated silica's have been used successfully in the coating industry. With the trend moving toward matted coatings, the demand for these products is steadily rising.

The silica matting agents are basically manufactured by two processes: the wet process and the thermal process. The thermal process is used only by Evonik. The wet process is divided into the gel process and in the precipitation process. Of these two processes, Evonik basically uses the precipitations process. Fundamentally, these matting agents consist of amorphous silica, which have a targeted d 50 laser diffraction agglomeration size of 4–14 µm and they have generally a narrow partial size distribution. Important requirements to matting agents are matting efficiency, high transparency, good anti-settling behavior and easy incorporation. However, with the growing environmental awareness and the legal requirements, major efforts from all partners in the coating industry have to be done. Attempts to meet these requirements go from reducing the solvent content of coating systems and the use of UV curing systems.

Another environmently friendly option is the use of water-dilutable systems. Generally speaking, waterborne coatings are easy to matt even though their incorporation and stabilization requires a special attention. At this point, it must be mention the adsorption of associative thickeners by matting agents based on silica which can result in sensitive storage stability. Polyurethane Thickener or HEUR (HEUR = Hydrophobically modified Ethoxylated Urethane Copolymere) consists of hydrophobic polyurethane chains, with hydrophobically groups at the end. These PU thickeners build a network with themselves and the emulsion particles. Hence they build up pseudoplasticity within the system and through the resulting thixotropicity settling and sagging is prevented.

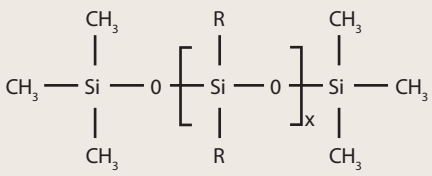
Silanol groups are responsible for the strong interaction between silica and Polyurethane thickener in aqueous systems. This means the rheology and especially the structural behavior is impaired. This applies to all silica.



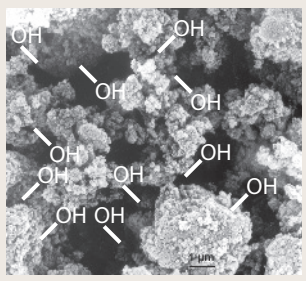
The picture on the left side shows the Network of Associative Thickeners in a waterborne system and the picture on the right side shows the thickener adsorption through the interaction of silica within the system.

PDMSD treated Silica

ACEMATT® 3300



Polydimethylsiloxane Derivate (PDMSD)



Schematic model of the reactive treatment with PDMSD

The picture shows a schematic model of the reactive treatment with PDMS derivate of ACEMATT® 3300. Due to novel treatment a shielding of silanol groups of the silica can be achieved.

ACEMATT® 3300 satisfies all these high requirements due to its unique chemistry as matting agent and the shielding of the silanol groups by its novel post treatment with PDMS (polydimetylsiloxan) derivates.

To demonstrate this, an extended investigation about the influence of matting agents on the formulation and on the coating properties has been done. For our experiments two modern and representative coating systems: a waterborne two-component PUR coating and a dual UV-curing acrylic dispersion systems. In addition to ACEMATT® 3300, the well proven ACEMATT® TS 100 and ACEMATT® OK 520 plus two well known competitor products have been also tested.

All tested coatings were adjusted on the same gloss with same dry film thicknesses. Generally speaking, matting agents, which are produced by the thermal process show the highest matting efficiency. Furthermore, the viscosity of both coating systems was adjusted on the same level. ACEMATT® 3300 shows clearly a reduced adsorption of associative thickeners compared to all other matting agents. Thereby less consumption of PU thickeners in the formulations is needed. This effect has been observed in lots of different waterborne coating systems.

In a next step, a storage test of 5 weeks at forced-heat of 40 °C has been carried out. A reduction in viscosity could be initially being observed. Later on an increase could be monitored. ACEMATT® 3300 was the only matting agent to exhibit stable viscosity. This in turn also leads to a benefit of a better settling behavior and thus an increase of the storage stability. This was also proven by conducting a settling test by using a centrifuge, according to our experience, this corresponds to 4 weeks of storage at 23 °C. None of the matting agents produced a sedimentation that was not redispersible, only ACEMATT® 3300 showed no separation of lacquer and matting agent. Furthermore it is also proven that a PDMS treatment does not only improve the sedimentation behavior of waterborne systems. It also improves the sedimentation behavior in solvent born coating systems.

Another focus of this examination was the chemical resistance. The test consisted of 24 hour loading of the coating with conventional chemicals like, deionized water, 48 % alcohol, coffee, red wine and red vinegar. As it is visible in Table 1 and 2 here, too ACEMATT® 3300 demonstrated its excellent suitability for these systems. To compare the chemical resistance, the delta E* difference was measured after a chemical exposing time of 24 h at ambient room temperature. A low delta E* value means a good chemical resistance.

Table 1

	Deionized Water	Alcohol 48 %	Coffee	Red Wine	Red Wine Vinegar	Average
TS 100	0.46	1.37	0.99	3.0	6.3	2.4
3300	0.46	1.27	1.30	3.5	5.7	2.4
OK 520	1.15	1.28	1.18	4.5	5.9	2.8
Comp. A	0.35	0.53	0.86	6.4	6.3	2.9
Comp. A	0.92	0.67	1.09	6.6	7.0	3.3
Average	0.67	1.02	1.08	4.8	6.2	2.8

Table 1: Chemical resistance of system A (waterborne two-component PUR). The resistance was measured as the degree of irreversible change on the colour difference delta E*

Table 2

	Deionized Water	Alcohol 48 %	Coffee	Red Wine	Red Wine Vinegar	Average
TS 100	8.2	1.3	3.5	2.8	2.3	3.6
3300	6.5	1.9	3.3	2.4	1.7	3.2
OK 520	8.2	1.0	4.6	1.4	0.9	3.2
Comp. A	8.0	3.0	5.7	4.1	3.7	4.9
Comp. A	9.6	3.0	8.4	6.3	5.0	6.5
Average	8.1	2.0	5.1	3.4	2.7	4.3

Table 2: Chemical resistance of system B (waterborne dual UV-curing acrylic dispersion system). The resistance was measured as the degree of irreversible change on the colour difference delta E*

The experiments showed that in the tested coatings, our proven matting agents ACEMATT® TS 100 and ACEMATT® OK 520 already achieve good results for the required properties. The use of ACEMATT® 3300 offers additional advantages in the formulation of waterborne coatings in terms of minimization of thickener adsorption,improved storage stability, chemical resistance, film transparency and suspension behavior.

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