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Filler comparison

Neuburg Siliceous Earth in

solvent-based facade paints

Optimization of breathability

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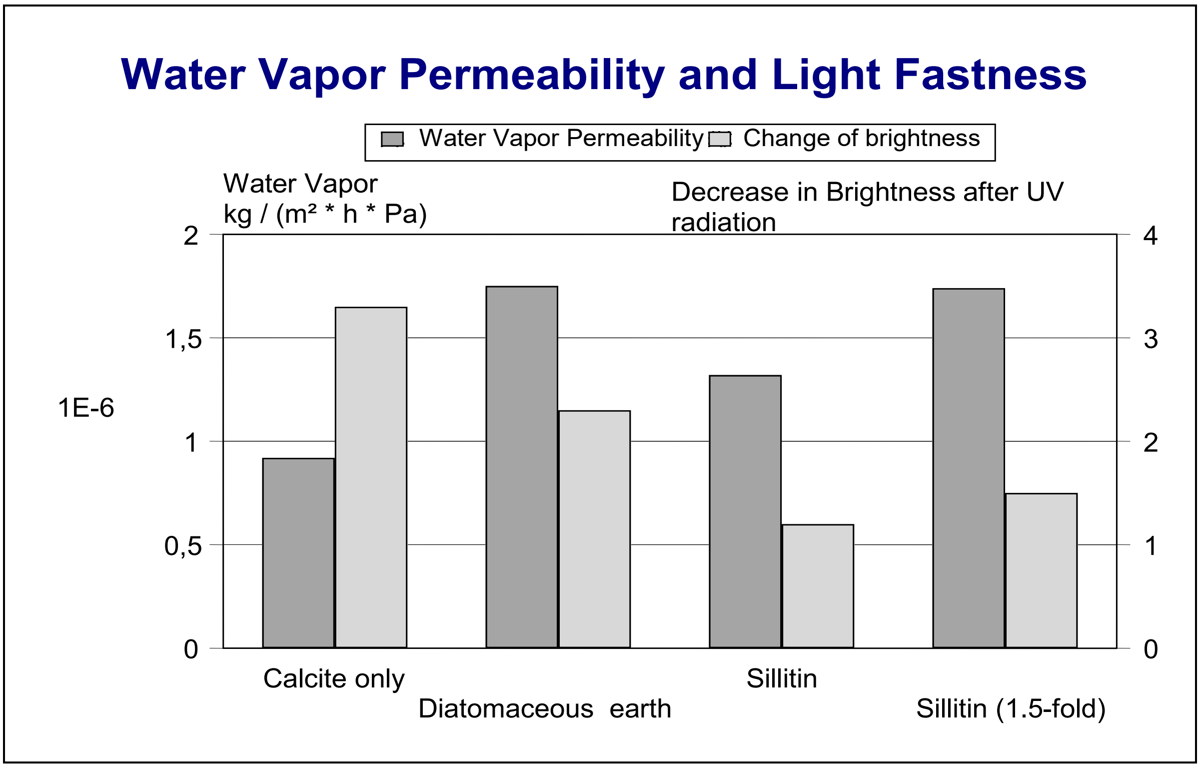
Summary

Silicate fillers are used in high-quality facade paints - particularly in those applied to exterior surfaces and humid rooms - the effectiveness of which is improved in a most significant manner.

The same applies, generally and by analogy, to moisture-affected masonry. The quality-improving capacity of silicate fillers is reflected by a considerable increase in the vapor permeability. As a rule, one can say that the respiratory activity - beneath the crucial pigment volume concentration, hence an optimal weather resistance will remain insufficient unless silicate fillers are used.

Sillitin and diatomaceous earth proved to be best, whereby the somewhat higher Water Vapor Permeability of diatomaceous earth can be compensated by a higher Sillitin dosage. Price-effectiveness is one more reason to use Sillitin.

Additionally one can say that the silicates, especially Sillitin, in spite of initial values slightly inferior to those of the comparison materials, were capable of improving the light fastness.



C O N T E N T S

1 Introduction

The properties of facade paints are affected by practically all the raw material components used in the recipe. This means that special care must be taken when choosing a binder, pigment or filler, as these are major constituents in the formulation and will have an effect on its fundamental characteristics.

The main requirements placed on facade paints are good weather and chemical resistance, as well as water-vapor permeability as a criterion for a paints ability to "breathe".

In practice, good weather and chemical resistance can be achieved easily using available binders and additives and calcite, a low-priced material.

However, considerable improvement of a paints breathing ability can only be achieved by increasing pigment volume concentration (PVC) above the critical level. This is achieved at the cost of poorer service quality, so that this cannot be regarded as a realistic solution. Here is where silicate fillers take over, giving improved water vapor permeability at unchanged PVC levels. Tests involving the partial replacement of calcite with diatomaceous earth show considerable improvements in quality, leading to higher technical standards for facade paints, albeit at much greater formulation costs.

2 Objectives

This test series was designed to improve breathing activity using silica fillers, at the same time taking cost factors more fully into account. Using a realistic film thickness, the study objective was to achieve a water vapor permeance of minimum $1.25 \cdot 10^{-6} / (m^2 \cdot h \cdot Pa)$ as a technical standard for 1 cm lime-cement plaster.

3 Testing

3.1 Raw Materials

Basic components		
Product name	Description	Manufacturer
Pliolite VTAC	Binder, Vinyltoluene/Acrylate	Goodyear
Pliolite AC 3 (10 % in Xylene)	Rheology-additiv, Vinyltoluene/Acrylate	Goodyear
Chlorparaffin 40	Softener	Clariant GmbH
Chlorparaffin 70 AG	Softener	Clariant GmbH
Soja lecithin	Wetting agent, Soya Lecithin	Hanf & Nelles
White spirit	Solvent	
Shellsol A	Solvent	Shell
Aerosil	Thixotropic agent, Fumed Silica	Degussa-Hüls
Titanium dioxide	White pigment	Kronos AG
Micro Mica	Filler, Mica	Norwegian Talc
Plastorit 00	Filler, Coalescence of Mica, Quartz and Chlorite	Naintsch

Fillers					
Product name	Density g/cm³	Brightness Y-value	d_{50} µm	Oil absorption g/100 g	Price index Diatomaceous earth = 100
Calcite	2.7	87.2	2.1	29	9
Diatomaceous earth	2.3	91.6	6.7	114	100
Sillitin Z 89	2.6	86.6	1.7	50	14

3.2 Recipes

Raw materials	Recipe R0	Recipe R1	Recipe R2	Recipe R3
Pliolite VTAC	7.5	7.5	7.5	7.5
Pliolite AC 3 (10 % in Xylene)	3.0	3.0	3.0	3.0
Chlorparaffin 40	4.0	4.0	4.0	4.0
Chlorparaffin 70 AG	3.5	3.5	3.5	3.5
Soja lecithin	0.5	0.5	0.5	0.5
White spirit	15.0	15.0	15.0	15.0
Shellsol A	15.0	15.0	15.0	15.0
Aerosil	0.3	0.3	0.3	0.3
Titanium dioxide rutile	20.0	20.0	20.0	20.0
Micro Mica	7.0	7.0	7.0	7.0
Plastorit OO	4.2	4.2	4.2	4.2
Calcite	20.0	12.0	12.0	8.0
Diatomaceous earth	---	8.0	---	---
Sillitin Z 89	---	---	8.0	12.0

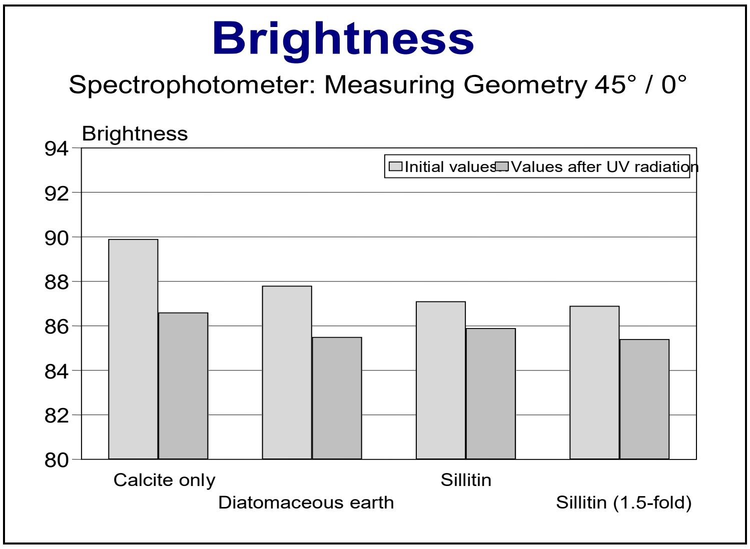
3.3 Preparation of Formulations

All recipes were dispersed by a laboratory dissolver in batches of 10 kilograms each, for 30 minutes. Before processing the viscosity was adjusted by the addition of white spirit to a flow time of 160 to 170 sec (DIN 53 211).

4 <u>Laboratory Testing</u>

4.1 Brightness

The brightness was measured in a spectrophotometer (optical system: 45°/0°) against barium sulfate standard brightness, the luminous density (brightness) "Y" serving as a measure.



4.2 Resistance to UV-Radiation

Exposure to radiation by a mercury low-pressure burner S 40 was 72 hours, with the specimens arranged at distance of 30 cm. The brightness factor was determined as described under 4.1.

The decrease in brightness of the specimens containing Sillitin was found to be less than that of the specimens containing diatomaceous earth or calcite. In other words, the use of Sillitin in the formulation produces an improved light fastness.

4.3 Resistance to Chemicals

Asbestos cement sheets (150 x 30 x 2 cm) were coated on both sides with the facade paint and allowed to dry for one week. Afterwards the sheets were placed upright with half their length immersed in the following solutions for a period of 7 days:

tap water
1 % soap solution
5 % soap solution
5 % soda solution
5 % dish-washing agent solution

None of the solutions had any effect whatever.

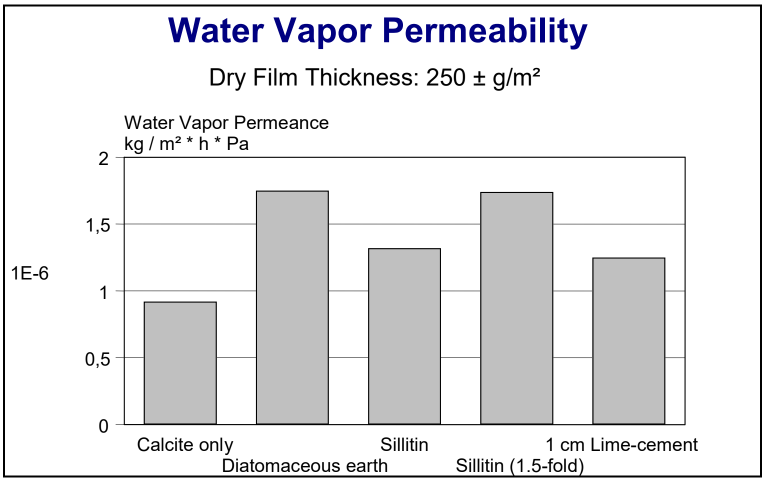
4.4 Adhesive Strength on Asbestos Cement

A double coating was applied to each of the asbestos cement sheets (150 x 10 x 3 cm) and allowed to dry out for 7 days, after which period a cross cut test (DIN 53 151) was made on each of them, the cutter-blade spacing being 2 mm. All specimens were given the quality level "0" (completely smooth cut edges, no scaling).

4.5 Water Vapor Permeability

Two layers of paint were sprayed on a filter paper. The solid matter was 250 ± 10 g/m^2 in total. Three disc-shaped sheets with a diameter of 91 mm were cut from each of the paint coated filter papers. Each of these sheets were placed, with the coated surface to the outside, on a receptacle. The contact area between the filter paper and the receptacle was sealed vapor-tight with paraffin.

Dry silica-gel was placed in the receptacle which absorbed rising water vapor, maintaining relative air humidity at around 2%. Outside the receptacle, air humidity was maintained at 98 ± 2% at a temperature of 20 ± 2 °C. The water vapor diffusing through the sample was determined by re-weighing, a mean value being calculated from three measurements.



Using this method, water vapor permeability can easily calculated, as follows: kg (water vapor) / m² (sample surface area) - hours - Pa (water vapor partial pressure).

Recipe	Water Vapor Permeance
R0 (Calcite) R1 (Diatomaceous earth) R2 (Sillitin 1-fold) R3 (Sillitin 1.5-fold)	$0.92 \cdot 10^{-6}$ kg / (m²·h·Pa) $1.75 \cdot 10^{-6}$ kg / (m²·h·Pa) $1.32 \cdot 10^{-6}$ kg / (m²·h·Pa) $1.74 \cdot 10^{-6}$ kg / (m²·h·Pa)
1 cm lime-cement plaster	$1.25 \cdot 10^{-6}$ kg / (m²·h·Pa)

The results show that much higher values are achieved with diatomaceous earth and Sillitin compared to calcite. The reference values for lime-cement plaster can be reached (Sillitin 1-fold) or even exceeded (diatomaceous earth, Sillitin 1.5-fold). The last two even meet requirements where extremely difficult real conditions are applied.

4.6 Resistance to trapped moisture (Blister box)

Asbestos cement sheets (150 x 100 x 3 mm) were given a double coating of 400 ± 30 g/m² paint. After a 7-day drying period, the sheets were attached - coated side out - vapor-tight to a receptacle. The water was then kept at 80 °C for 7 days, thereby exposing the reverse side of the sample continuously to 100% relative air humidity water vapor pressure at 80 °C. The reverse side of the sample was constantly covered with condensed water. The samples were assessed after 7 days. Samples R1, R2 and R3 remained unchanged, while there was isolated evidence of pin-head sized blisters on sample R0.

4.7 Wash-resistance according to DIN 53 778 Part 2

No surface damage whatever to the samples could be determined following 10,000 double strokes with an Erichsen brush.

4.8 Storage Stability

4.8.1 Sedimentation

Specimens each 1-kg were evaluated upon completion of a 28-days storage period at 40 C.

1 = completely homogeneous

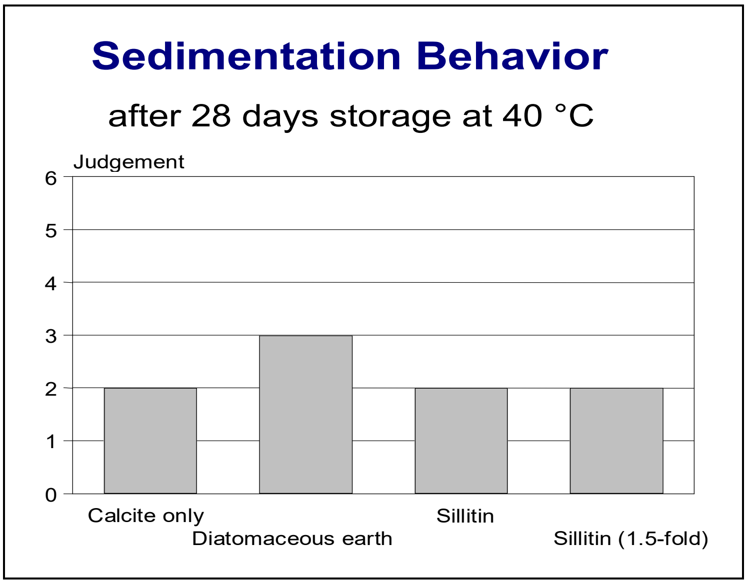
2 = slightly inhomogeneous, no sedimentation

3 = slight sedimentation, readily correctable by stirring

4 = heavy sedimentation, readily correctable by stirring

5 = heavy sedimentation, difficult to correct by stirring

6 = heavy sedimentation, correctable by mechanical means only.



4.8.2 Viscosity Stability

After 28 days of storage at 40 °C all paints were homogenized. The viscosity was measured by means of a viscosity cup (4 mm, DIN 53 211). All specimens showed an increase in the viscosity from 5 to 10 seconds, which means in fact no alteration.

5 Application-orientated Testing

5.1 Processibility by the Airless Spraying Method

A quantity of 8 kilograms of each of the paints tested was applied by means of a Graco Airless Spray Gun (primary pressure = 6 bar; transmission = 32 : 1). All specimens could be processed without any problem.

5.2 Outdoor exposure

The test paints were applied by roller in two variations - first diluted with 20 % white spirit, second undiluted - to asbestos cement sheets; the total quantity applied was 400 ± 30 g/m^2. The sheets were then placed at an angle of 45° outdoor directed to the south. Apart from slight chalking, the specimens did not show any alteration whatsoever upon termination of the 9-month test period.

6 Assessment

All tests involving solvent-containing plaster paints impressively demonstrated the advantage of partially replacing calcite with silicate fillers, in particular Sillitin. This particularly applies with regard to such major characteristics as water vapor permeability, or capillary water absorption resistance.

In line with its objectives, the test program focused attention on water vapor permeability. This means that the measurements obtained for water vapor permeability and the blister box tests are highly significant when judging performance under extreme conditions involving wet exteriors, or where dampness penetration of walls is likely due to planning and/or construction errors or damage.

The short outside weathering testing period could not, and was not intended to, reveal any significant differences in the mean lifetime of a plaster paint.

The study comes to a clear conclusion: only by adding silicate fillers can the mean water vapor permeance of $1.25 \cdot 10^{-6}$ kg / ($m^2 \cdot h \cdot Pa$) in a 1 cm thick layer of lime-cement plaster be exceeded as a technological minimum value in a healthy wall finish. The slightly lower values obtained by Neuburg Siliceous Earth compared to diatomaceous earth can be compensated by using higher doses. Unlike diatomaceous earth, this only results in a slight increase in raw material costs in the plaster paints tested here.

The price-to-performance ratio weighs clearly in favor of using Sillitin!