ELEMENTIS

A global specialty chemicals company

Application Leaflet

BENTONE® OC & RHEOLATE® 101

Improved workability of cement patching compounds

Key Benefits

- Strong thickening response
- Enhanced thixotropy
- Optimized troweling

Introduction

Cement based patching compounds are used to fill and repair cracks, replace missing concrete or to resurface spalled concrete. The different applications will require different rheological properties. Products may vary from those needing a high degree of thixotropy for patching vertical and overhead surfaces to the other extreme which are products that will flow out to a level surface for repairing floors or pavement.

The formulations given below represent general purpose patching compounds that could be used to repair cracks or spalls in sidewalks, curbs, block walls or other light duty applications. These formulations could also be used as a thin top-coat (plaster) over brick or concrete block walls or over damaged concrete. Such patching compounds are mixed with water to a paste-like consistency and applied to the crack or hole being filled or onto the surface being restored using a steel trowel. Important considerations are how easily the mixture can be spread over a surface or used to fill a cavity and, for vertical surfaces, how well the mixture stays in place after the trowel is pulled away.

BENTONE® OC and RHEOLATE® 101 have been found to be useful in improving the workability of trowelable cementitious patching compounds and plasters.

Benefits

- Improved thixotropy for patching vertical and overhead surfaces
- Improved troweling combined with reduced stickiness on the tool
- No impact on setting times
- Strong thickening response in cement mortars
- No effect on mortars density

BENTONE® OC

Composition	Untreated natural Hectorite clay
Form	Free flowing, brownish to creamish powder
Particle size < 74 µm [%]	95
Density [g/cm^3]	2.60

RHEOLATE® 101

Composition	Proprietary acrylic
Form	White, finely divided powder
Non volatile content [%]	100
Density [g/cm^3]	1.20

General purpose patch comp.

It is often difficult to measure the viscosities of mortars or patching compounds containing sand or other relatively coarse aggregates. The viscosity curve in *Figure 1* was generated using a Brabender Visco-Corder which uses a paddle style spindle and which can accommodate relatively stiff or highly viscous materials.

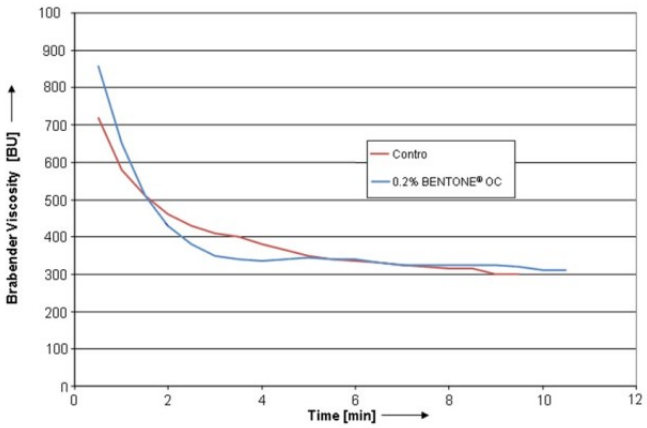

Figure 1: Viscosity of patching component

In this graph it can be seen how BENTONE® OC provides a higher initial viscosity which is reduced more rapidly, compared with the control, to a low viscosity level. In application, this relates to better trowel application properties. The mortar shows less sag or slump (higher viscosity) when not being sheared (trowelled) but is easier to trowel once force is applied.

In comparing cementitious formulations it is important to maintain the same or similar water/cement ratios! The ease of troweling can be improved by increasing the water level, however the strength of the cured patching compound will be reduced and shrinkage, which may lead to cracking, will be increased. In *Result table 1* effect of 0.2% BENTONE® OC added to the general purpose patching compound formulation provided above. Hydrated lime is also used sometimes to improve the rheology of patching compounds. Lime increases the corrosivity of the patch, however, and may increase efflorescence (deposition of white salts on the surface of the cured patch).

Patching compounds containing BENTONE® OC and hydrated lime were compared to a control, which did not contain any rheology modifier. The results of this evaluation are listed in Table I. Water levels were held constant for these evaluations. The density of the freshly mixed patches were all about the same. Density is a measure of the amount of air entrained in a cementitious mixture. Any reduction in density would be expected to reduce the strength of the cured patch.

	Control	0.2% BENTONE® OC	3% Hydrated lime
Water demand [ml/100g]	16.0 in all cases		
Density [g/ml]	2.14	2.14	2.13
Flow at __ [%]			
5 minues	74	71	60
30 minutes	61	65	50
Change of flow rate [%]	18	8	16
Set time [h:min]			
Initial	4:00	4:10	3:10
Final	5:30	5:30	4:30

Result table 1: Patching compound properties

Flow was measured based on ASTM C230. The flow measurement is often used when working with cementitious materials and is widely regarded as a meaningful measure of workability. The viscosity of the mortars, as measured using the Brabender viscometer, for example, may be a better indicator of the workability of a patching compound. The higher the flow value the more fluid the mix.

The use of BENTONE® OC results in a slightly reduced flow than the control when measured five minutes after mixing. Hydrated lime produces a significantly lower flow compared to the control. In repeating measurement after 30 minutes, the patch modified with BENTONE® OC displays less of a reduction in flow with time compared to the control or to a patch modified with lime. This means that BENTONE® OC provides a more consistent workability over time than the control formulation.

The initial and final setting times of the patching compounds were measured using Gilmore Needles. BENTONE® OC has virtually no impact on setting times. Hydrated lime on the other hand accelerates the set times compared to the control.

Polymer modified patch comp.

Figure 2 shows the viscosity for the polymer modified patching compounds. In some cases these products will exhibit early stiffening or setting of the patching compound resulting in a short working time or pot life. This is sometimes referred to as a "false set" and is seen in *Figure 2* as a steady and relatively rapid increase in mortar viscosity. Remixing the patching compound and adding additional water to extend the working time will result in lower strength levels. Hydrated lime is sometimes used to improve the workability of cement mortars, however, the lime did not provide any improvement in working time in this patching formulation.

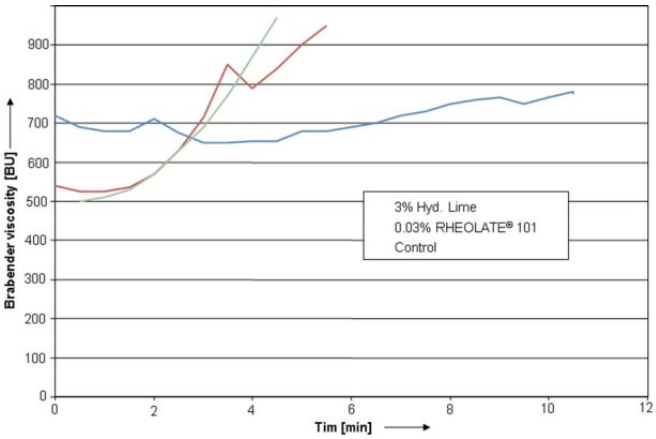

Figure 2: Viscosity of polymer mod. patch component

The addition of very small amounts of RHEOLATE® 101 rheology modifier to the polymer modified patch formulation provides a consistent viscosity over time and extended the working time or pot life. The RHEOLATE® 101 also reduces the stickiness that is often a problem with dry polymer modified patching compounds.

Result table 2 shows the effect of RHEOLATE® 101 and lime on a dry polymer modified patching compound. The patching compounds containing RHEOLATE® 101 and lime both required slightly more mix water to obtain a similar, perceived workability.

	Control	0.03% RHEOLATE® 101	3% Hydrated lime
Water demand [ml/100g]	15.5	16.0	16.0
Density [g/ml]	1.96	1.98	1.95
Flow at __ [%]	73	58	65
Set time [h:min]			
Initial	5:15	6:00	5:00
Final	7:30	8:20	7:00
Trowel slip	poor	good	poor

Result table 2: Patching compound properties

In can again be seen that RHEOLATE® 101 acts as a strong thickener in this patching compound as shown in a reduced Flow. However, unlike many organic thickeners, the RHEOLATE® 101 does not entrain air in the mix but allowed the patch to maintain a slightly higher wet density.

The material formulated with RHEOLATE® 101 demonstrates the best workability.

The viscosity curve in *Figure 2* has already shown that in the control and the sample equipped with RHEOLATE® 101 exhibit early stiffening or setting of the patching compound resulting in a short working time or pot life. This is sometimes referred to as a "false set" and is seen in as a steady and relatively rapid increase in mortar viscosity. Remixing the patching compound and adding additional water to extend the working time will result in lower strength levels. Hydrated lime is sometimes used to improve the workability of cement mortars, however, the lime did not provide any improvement in working time in this patching formulation.

Appendix

Test methods:

Brabender viscosity

Measured by Brabender visco-corder equipped with paddle style spindle at a paddle speed of 150 rpm and a spindle with a 1000 cmg head.

Flow

Measured on a Flow Table in accordance with ASTM C230. The higher the flow value the more fluid the mix.

Setting times

Measured using Gilmore needles at a relative humidity of 90%.

Trowel slip

Judged visually during trowel application.

Test formulation

General purpose patching component

Compound	Concentration [%]
Portland cement Type 1 gray	30.0-X
Quartz sand 0.6 mm	30.2
Quartz sand 0.2 mm	39.7
Powder defoamer	0.1
Rheology modifier	X
Total	100.0

Polymer modified patching component

Compound	Concentration [%]
Portland cement Type 1 gray	30.0-X
Quartz sand 0.6 mm	30.2
Quartz sand 0.2 mm	37.7
Powder defoamer	0.1
Redispersible polymer powder	2.0
Rheology modifier	X
Total	100.0

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