MagPro
By Brucite+

Research report

«Comparative study of MagPro® and competitive samples of magnesium oxide for use in SMC/BMC composites»

Introduction

SMC (Sheet Molding Compound) and BMC (Bulk Molding Compound) are fiber-reinforced thermosetting semifinished products. They are produced in thin uncured and thickened sheets between 1 and 3 mm thick (SMC) or in the form of a loose formless mass (BMC) that can be handled easily.

Before molding, SMC are subjected to several handling operations such as charge cutting, folding, and placement in the mold. Such manipulations would not be possible without a significant thickening of the SMC pastes, even filled. Similarly, during compression molding, it would not be possible to induce the fibrous reinforcement flow within the mold without a high viscosity of the SMC paste. For these reasons, but also to prevent the phase separation within the resin itself after its processing, it is necessary to thicken the SMC paste, such a procedure being fundamental in the SMC process. For this purpose, a thickening agent is added into the paste during its processing.

The most used in SMC formulations are Group IIA metal oxides and hydroxides, such as oxide magnesium and hydroxide magnesium. These agents are incorporated (in the form of a dry powder or already dispersed in the resin for better homogenization) in the SMC paste with a nominal concentration ranging between 0,5% and 3% based on the resin and low profile additive.

The correct selection of thickening agent is extremely important in producing a high-quality composite without moulding flaws, cracks and undulations.

The Brucite+ brand produces two grades of highly active magnesium oxide, which are used as thickening agent in the manufacturing of SMC/BMC composites. The product under the trademarks MagPro®150 and MagPro®170 is high surface area magnesium oxide obtained by indirect calcination of milled natural magnesium hydroxide (brucite mineral).

Study objective

A variety of synthetic magnesium oxide grades with different surface area values is available on the market. The objective of the study is to show that MagPro® magnesium oxide obtained by calcination of natural magnesium hydroxide can be used as a thickening agent in SMC/BMC formulations, providing the thickening effect comparable with synthetic highly active grades of magnesium oxide.

Parameters of species

Species name	MagPro® 150	MagPro® 170	Competitor 1	Competitor 2	Competitor 3
Description	Natural magnesium oxide with SSA 150 m^2/g	Natural magnesium oxide with SSA 170 m^2/g	Synthetic magnesium oxide with SSA 125 m^2/g	Synthetic magnesium oxide with SSA 150 m^2/g	Synthetic magnesium oxide with SSA 175 m^2/g
MgO content, %	94.8	94.1	97.0	98.2	99.5
CaO content, %	2.34	2.75	0.95	0.80	0.30
SiO_2 content, %	1.57	1.10	0.20	0.35	0.03
Fe_2O_3 content, %	0.14	0.16	0.08	0.15	0.02
Particle size D_{50}, microns	7.0	7.0	3.0	5.0	1.5
Loss on Ignition at 950°C, %	7.3	8.6	7.0	8.0	5.0
Specific Surface Area, m^2/g	152	169	125	155	175

Test formulation

All experiments were performed on the same formulation:

№	Ingredient	Characteristics	Content, % by weight
1	Unsaturated polyester resin	Brookfield viscosity: 1250 cPs Specific gravity: 1,10 g/cm^3 Acid value: 17 mg KOH/g Styrene content: 40% by weight	99.5
2	Highly active magnesium oxide	Specific Surface Area — 125 to 175 m^2/g	0.5

Test procedure

The compounds were prepared on a D-Lab OS20S high-speed mixer for 10 minutes at 200 rpm.

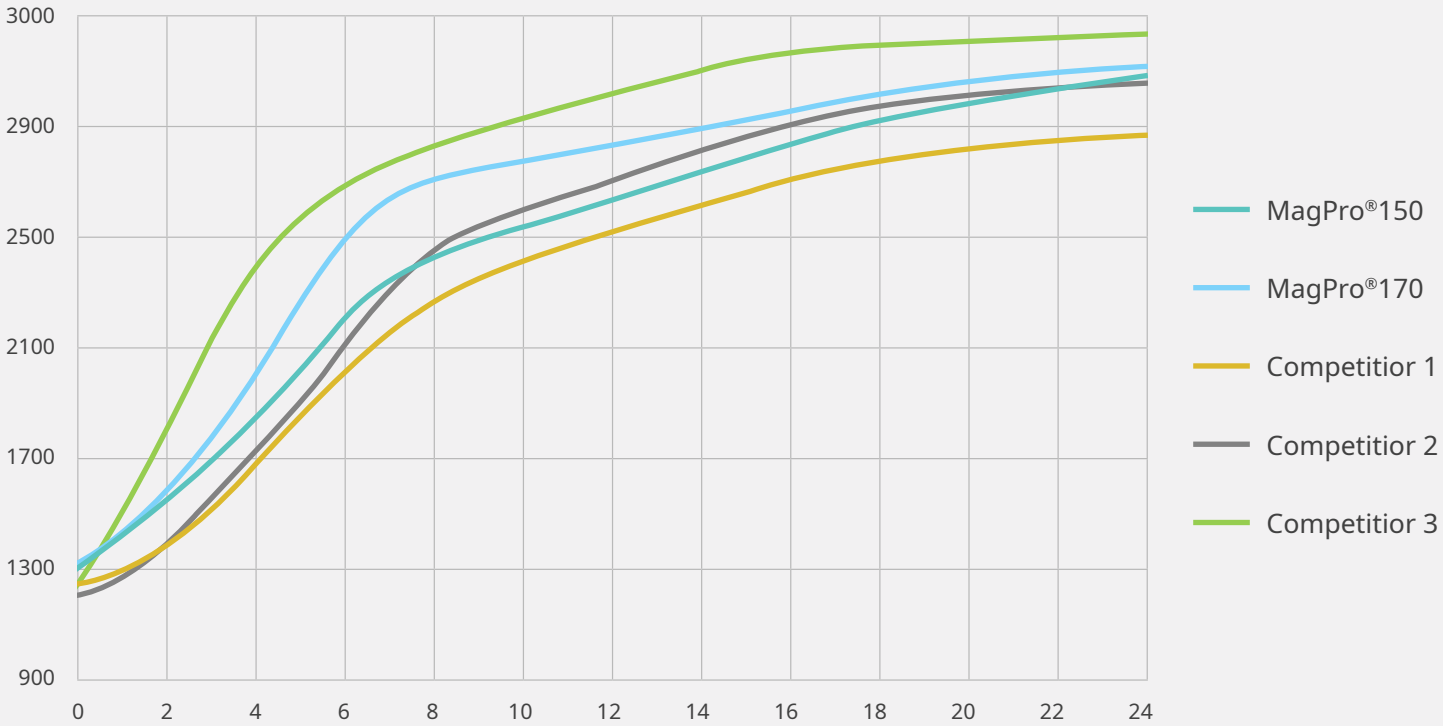
The viscosity of the prepared compounds was measured on a Brookfield viscometer using the LV-04 spindle (64). The duration of the viscosity measurement for each compound was 24 hours with an interval of 1 hour in the first 8 hours after mixing and 2 hours in the subsequent. All compounds between measurements were constantly mixed at 200 rpm to prevent the sedimentation of magnesium oxide.

Based on the measured results, the curves “compound viscosity – time” were drawn for each of the five compounds.

Test results

Compound	Viscosity initial — 0 hours, cPs	Viscosity after 8 hours, cPs	Viscosity after 16 hours, cPs	Viscosity after 24 hours, cPs
MagPro® 150	1272	2410	2825	3066
MagPro® 170	1308	2700	2945	3108
Competitor 1	1254	2250	2690	2858
Competitor 2	1205	2450	2905	3050
Competitor 3	1230	2815	3155	3223

Thickening curves for all compounds

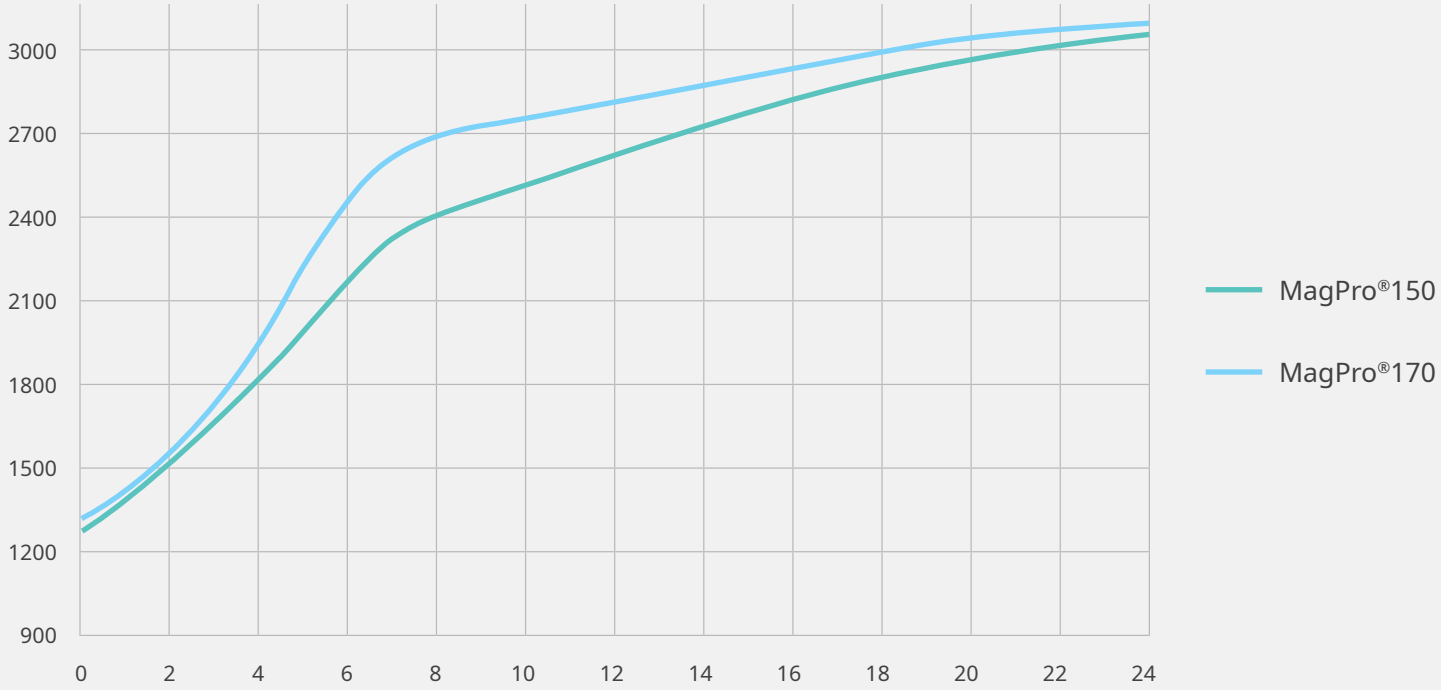


Conclusions

1. The main parameter that determines the thickening velocity of the unsaturated polyester resins based compounds is the Specific Surface Area of magnesium oxide.
2. Magnesium oxide content in the range of 94,0–99,5 % for the selected grades does not affect significantly the thickening velocity of the unsaturated polyester resins based compounds.
3. Magnesium oxide particle size of in the range of 1,5–7,0 microns for the selected grades does not affect significantly the thickening velocity of the unsaturated polyester resins based compounds.
4. Magnesium oxide origin (natural or synthetic) does not affect significantly the thickening velocity of the unsaturated polyester resins based compounds.

Additional materials

MagPro® thickening curves



The different values of the Specific Surface Area allows you to choose MagPro® grade suitable for use in your SMC/BMC formulation and to reach optimal thickening/economy rate.

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