

## Dow Performance Silicones

## Dow and Nubiola Join Forces to Develop Long Term Stable Blue Cementitious Formulations

**DOWSIL™**

Case Study: Range of Stable Blue Colour Formulations for Mortars



Photo courtesy of Nubiola

**City and Country**

Barcelona, Spain

**Product\***

- DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder

**Key Participant**

- **Pigment Manufacturer**  
Nubiola

\*Prior to February 2018, products listed were branded as Dow Corning.

### Background

The market for coloured cement and mortar based products is diverse and continues to grow in popularity, which is due in part to the cost effectiveness of this type of construction. Example applications include architectural concrete masonry units, mortar for facades, segmental retaining walls, tile grouting and paving products which are offered in different shapes, colours and textures. This expansion in demand and product range has led to an increased expectation in performance; specifically durability, appearance and colour stability. However, matching the

creative aspirations of designers with colour consistent, long lasting cement based products continues to create an industry-wide issue for manufacturers. This is due to their high alkalinity and a restriction in the number of available pigmentation options and production methods to achieve integrally coloured materials.

### The Challenge

There is a particularly strong customer requirement for development of a reliable system of pigmentation for the colour blue. Cement may only be coloured using inorganic pigments due to its high

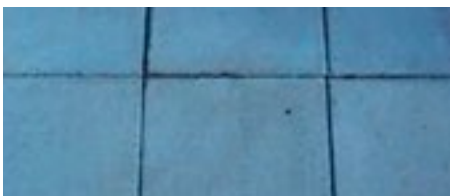
alkalinity and until now, pigment choices have been limited to Cobalt Blue and Ultramarine Blue – both of which are sensitive materials and exhibit inherent shortcomings such as colour fading, an inability to obscure the background of a contrasting colour and high price. Ultramarine Blue is notoriously unstable, which can be linked to the formulation choice and the setting of the mortar where system conditions and chemical reactions during the cement hydration process can be most aggressive.





## Real Customer Case

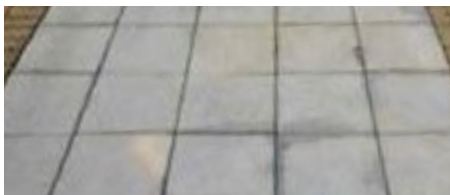
Initial formula 50% cement, 80% aggregates (quartz and calcaceous), 4% pigment (vs cement). No additives used in the formula.



Starting Point



+30 Days



+90 Days

Photos courtesy of Nubiola

Nubiola, the world's largest producer of Ultramarine pigments, launched a new range of Ultramarine Blues three years ago which are capable of working in cementitious formulations; the Nubicem B series. This is clearly a step forward for the use of blue in cement based materials but in certain conditions, mainly when humidity or water in the system is severe, some fading issues occur. So to ensure the durability of Nubicem B series for long term, mainly outdoor conditions, the use of hydrophobic additives is recommended.

## The Solution

Tests conducted by world leading inorganic pigment manufacturer Nubiola had previously concluded that water ingress was the main cause of the accelerated colour fading in the Ultramarine Blue pigment and could be attributed to the presence of water during setting, cure and when in use.

Following consultation with Dow, Nubiola embarked on a 2 year research programme which set out to examine

the use of water retaining additives for water control and hydrophobic agents for pigment stability. Products under test included cellulose ether for water retention (test specimen N2) and DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder (test specimen N4), as well as stearates (test specimen N3) as organic based alternatives for the hydrophobic agents. Also tested was a combination of the water retention additive and DOWSIL GP SHP 50 Silicone Hydrophobic Powder (test specimen N6) and a combination of the water retention additive and stearate (test specimen N5). Untreated control samples (test specimen N1) were also placed under test for the duration of the research programme as a reference.

Crucially, Dow expertise enabled their silicon-based hydrophobic admixture to be converted from a liquid to a powder to ensure suitability with dry mix market requirements. Specialists from Dow also worked in close association with Nubiola to establish ways in which the formulation could be mixed.

Experimental Procedure	
Sample	Composititon
Aggregates (Quartz and Calceous, 80 %)	
Cement Type I (20 %)	
Nubicem B-101 (4% vs Cement)	
N1	No Additives
N2	+ Cellulosic Fiber
N3	+ Stearate
N4	+ DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder
N5	+ Stearate + Cellulosic Fiber
N6	+ DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder

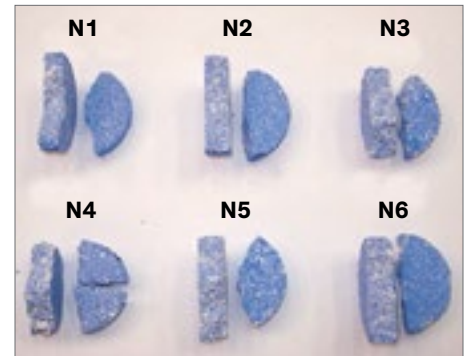
- Methyl Ethyl Hydroxyethyl Cellulose (Bermocoll ML11) as Water Retention Additive
- Stearate and Silane (DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder) as Hydrophobic Agents
- Samples prepared in a Lab Press with a W/c 0,27
- Curing 5 days at > 95 % RH

The results clearly demonstrate that DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder (test specimen N4) outperforms conventional hydrophobic powders like stearates (test specimen N3) to prevent fading of Ultramarine Blue pigments. That result is confirmed as well in combination with the water retention additive cellulose ether where DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder (test specimen N6) clearly demonstrates a much better protection of the colour pigment versus the stearate (test specimen N5). DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder is evenly distributed within the bulk of the system, thus offering a homogeneous and more complex level of protection for the Ultramarine Blue pigment embedded within the cement matrix.

Controlling the availability of water during the setting and curing of the cement by addition of methyl ethyl hydroxyethylcellulose was shown to have a positive impact on the cement matrix formation.

### DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder

This easy to use admixture increases water repellency and reduces water penetration and absorption in all types of cement based construction materials. Supplied as free-flowing powder which is easily dry mixed, DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder makes materials more hydrophobic and resistant to damage of the structure or aesthetic deterioration caused by excess water ingress.



Samples shown are following setting and curing after 5 days at > 95% RH, at the beginning of the 2 year research programme.



External surface of samples following 2 years of outdoor exposure in Barcelona.



Photos courtesy of Nubiola

Internal surface of samples following 2 years of outdoor exposure in Barcelona. Samples N4 and N6 prepared with DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder show improved colour retention after aging due to the protection from water ingress in the bulk of the formulation, when compared to the other samples which show colour fading.

Nubiola also engineered the use of Ultramarine Blue colour pigments for compatibility with cement formulations. Their technical skills for pigment encapsulation have enabled the protection of the Ultramarine Blue particle against the high alkalinity of the surrounding cement.

Ultramarine Blue may now be successfully used in mortars and other cement based materials in combination with DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder to provide excellent colour stability and a durable aesthetic appearance. Marketed under the Nubicem brand, with the use of different additives and control of working conditions, it is possible to ensure the performance and colour durability of this unique product offering in a range of applications.

Nubiola recommends the use of their Nubicem B series in combination with DOWSIL GP SHP 50 Silicone Hydrophobic Powder in the concrete formulation

in order to boost the performance and enhance the durability for bright, shiny, long-last aesthetics.

Dani Lladó, (Business Development Manager for Construction) of Nubiola commented, 'The continuing trend for the use of colour in modern construction strengthened our resolve to address the long-standing problems associated with blue pigmentation of mortars and concrete. Working in collaboration with [Dow] and being able to draw on their technical expertise has been pivotal in identifying a solution. [DOWSIL] GP SHP 50 Silicone Hydrophobic Powder is easy to use and our extensive research programme has confirmed its high performance in this sensitive application'.

During the research programme, Dow continued the development of their hydrophobic technology and has now released an advanced hydrophobic powder which contains a stronger blend of active

ingredients which are encapsulated. Designed to outperform most of the existing solid hydrophobic additives, the innovative product formulation of DOWSIL™ GP SHP 60 Plus Hydrophobic Powder is now commercialized in several drymix applications.

## For More Information

Dow is collaborating with industry professionals around the world to develop solutions to improve the energy efficiency of buildings for a more comfortable environment. Learn more about Dow's full range of High Performance Building solutions by visiting us online at **[consumer.dow.com/construction](http://consumer.dow.com/construction)**.

Dow has sales offices, manufacturing sites and science and technology laboratories around the globe. Find local contact information at **[consumer.dow.com/ContactUs](http://consumer.dow.com/ContactUs)**.

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