

**Vicky James**, Dow Corning, dispels the beliefs surrounding the use of silicones in paints, coatings or ink formulations

# Silicone polyethers enhance coatings



There are many applications that require good water resistance, for example in inks, wood coatings and architectural paints. In the Do-It-Yourself market for architectural paints, silicone resin emulsions have been used for water resistance for a number of years in the industry, where the formulator replaces a proportion of the acrylic resin emulsion with the silicone, at levels beyond those considered to be 'additive levels' and at >5% of the total formulation by weight. While this improves performance to a degree, it can also add significant cost. Dow Corning 87 Additive can be used at additive addition levels (typically 2-5% of the total formulation) to give improved water resistance and improved water beading without the need for an additional additive

After many years as a supplier to the coatings, paint and inks industry, I am still massively surprised when I come across a formulator who still does not use silicones in some way or another in their paints, coatings or ink formulations. It seems that there is still a belief in the industry that silicones are the evil enemy, the instigators of mayhem and disaster when it comes to surface craters and contamination, and that some formulators will not even entertain them in their factories. While it's still true that pure polydimethyl siloxane (PDMS) can often, cause issue, the fact is that silicone chemistry has changed beyond recognition since it was first introduced to the paint industry many years ago. Functionalisation of the PDMS with organic moieties such as ethylene or propylene oxide, alkyl or aryl groups or clever emulsification techniques means that today they are now compatible with most coatings formulations and indeed can be used to lower surface tensions and eliminate defects. Great problem solvers, silicones can also bring an enhanced, differentiated performance to coating that the end-consumer will value. How? Well, for example:

## SILICONE POLYETHERS FOR ENHANCED SLIP AND HAND FEEL

Silicone polyether technology has been available to the formulator for wetting, levelling and increased slip performance for some years. The low molecular weight and high hydrophilicity of these materials (due to polyoxyalkylene side chains) gives excellent compatibility in wood coating formulations, but performance can vary significantly from one formulation to another. These previous technologies also lack the high degree of slip performance that high molecular weight silicone can bring and the resulting hand feel is not luxurious or valued by the end-consumer. The Dow Corning 205SL Additive offers the formulator the chance to create a coating with a high degree of slip and a soft, silky hand feel that the end customer will appreciate.

This universal additive can bring a silky hand feel in sol-

ventborne, waterborne and radiation curable formulations, as shown in **figure 1**, thereby offering the formulator opportunities in many different areas of his portfolio.

Incredibly rare for a surface modifier, Dow Corning 205SL Additive is a multi-functional additive and is an effective defoamer. This offers the formulator an opportunity to potentially remove the defoamer in their formulation.

## HIGH MWT SILICONES FOR SLIP AND ABRASION/RUB RESISTANCE

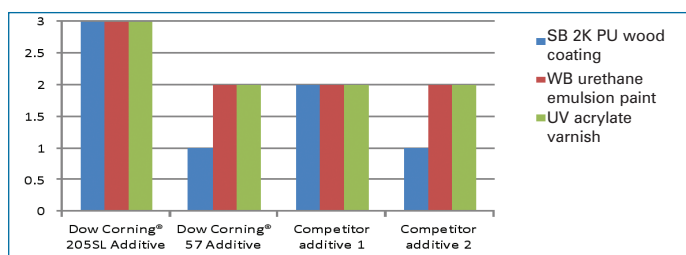
While abrasion or rub resistance is often intrinsically linked to slip by the formulator, excellent abrasion resistance with silicones comes with high molecular weight polymers. One may think that this renders them difficult to disperse and incompatible with organic binders but with suitable emulsion technology this need not be the case. Dow Corning 51 and 52 Additive are high molecular weight silicone emulsions that can be dispersed into waterborne coatings to create abrasion resistance surfaces.

These high molecular weight silicone emulsions can significantly out-perform traditional waxes used to lower slip properties. In **figure 2** the Coefficient of Friction of a waterborne polyurethane dispersion-based coating is lower using Dow Corning 52 Additive at 1/10th of the addition level to the formulation when compared to synthetic waxes.

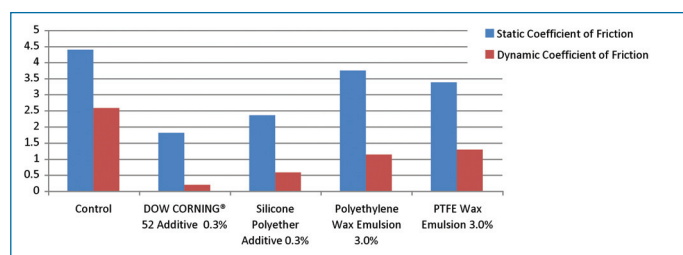
## WATER RESISTANCE AND WATER BEADING

**Figure 3** illustrates how Dow Corning 87 Additive can improve the water repellency of an architectural paint (the water absorption, or so-called W24 value, is lowered) while the water beading effect is improved (higher contact angle indicates a higher degree of hydrophobicity with more pronounced water droplet formation). The water beading effect has been shown to be persistent with weathering, remaining consistent after 1500hrs QUV exposure. Furthermore, Dow Corning 87 Additive does not bring negative attributes such as increased dirt-pick up, water staining or reduced adhesion.

**Fig 1.** Hand feel evaluation of Dow Corning 205SL Additive in three different coatings formulations. Additives added at 0.2% actives into the total formulation



**Fig 2.** Coefficient of Friction of Dow Corning 52 Additive compared to synthetic waxes in a waterborne PUD dispersion based paint



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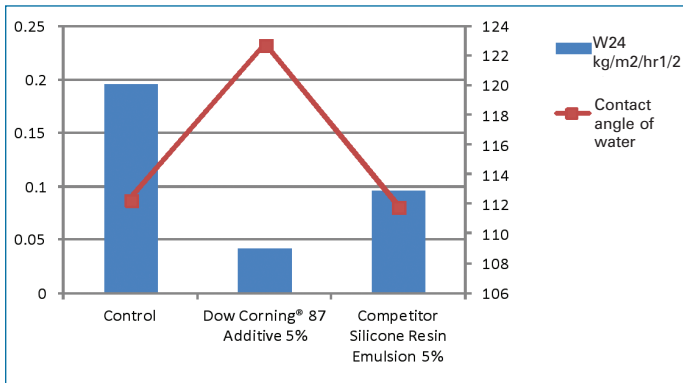


Fig 3. W24 and contact angle of water of a styrene-acrylic-based emulsion paint with and without Dow Corning 87 Additive and vs a competitor silicone resin emulsion

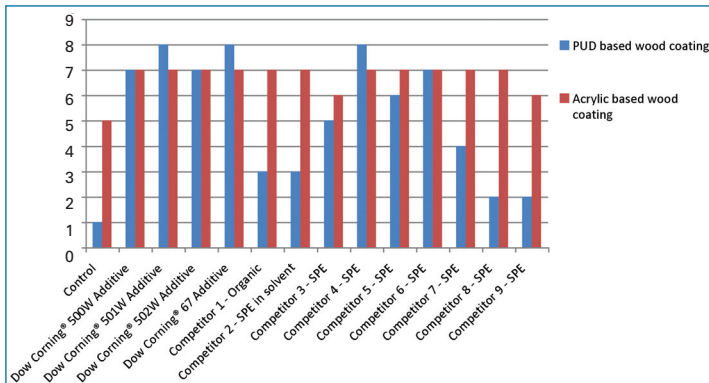


Fig 4. Surface appearance (wetting/levelling) of Dow Corning Superwetters vs organic and silicone-based surfactants, in waterborne PUD and acrylic wood coatings. Comparison is made at 0.2 % by weight in the total formulation (with the exception of competitors 1 and 2, which are at 0.4% to account for lower solids levels)

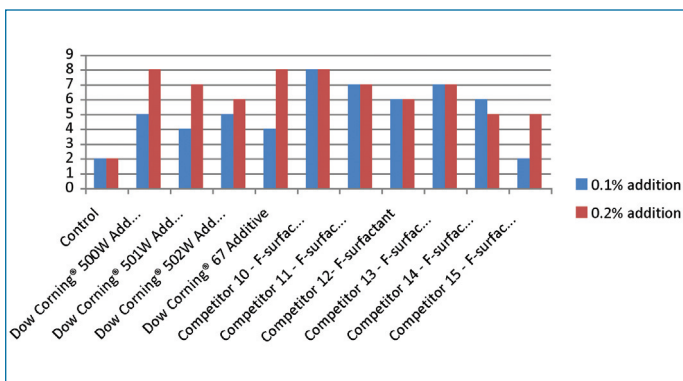


Fig 5. Surface appearance (wetting/levelling) of Dow Corning Superwetters vs fluoro surfactants in waterborne PUD wood parquet coating. Comparison is made at 0.1 and 0.2 % by weight in the total formulation

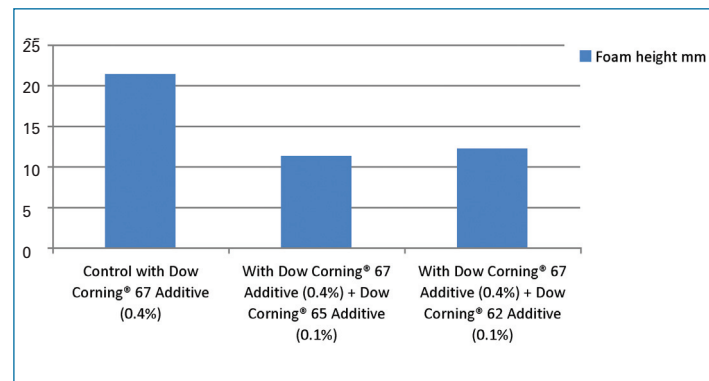


Fig 6. Foaming in waterborne flexographic gravure ink after high speed shearing with 0.4 % by weight Dow Corning 67 Additive and Dow Corning 62 or 65 Additive in the total formulation. Note Dow Corning 65 Additive is available as APEO-free version Dow Corning 68 Additive

**SUPERWETTERS FOR DEFECT-FREE SURFACES**

Dow Corning Superwetters are ready to deal with the most difficult wetting issues, particularly relevant for difficult to wet substrates such as wood and plastics. With Dow Corning 67, 500W, 501 and 502 Additives there is a family of products with consistent performance, which allows the formulator to choose the right product for a given application, giving a higher chance of formulating success while still minimising their raw material portfolio.

These materials can compete on a performance and cost-in-use basis versus organic, silicone and fluoro-surfactant technology on the market today. In figure 4 the visual appearance of two different wood coatings on glass can be seen with the Dow Corning Superwetter family versus organic and silicone-based competitive surfactants (1-9). The wetting performance of the Superwetters is high, with only some small differences between the products. Performance is consistent across both formulations and while some competitive additives perform well in one formulation, performance is poor in the other.

While constantly under scrutiny for their bio persistence, fluorocarbon-based surfactants are still used today for wetting. Effective at very low addition levels, they are also high cost. Six commercial fluoro-based surfactants (Competitors 10-15) versus the Dow Corning Superwetters have been evaluated. Figure 5 demonstrates the performance at 0.1 and 0.2% by weight to the total formulation in a waterborne polyurethane-based lacquer. While a higher addition level of the Superwetter is required to give the same performance as the fluoro surfactants, on

a cost-in-use basis they can be competitive, exemplified here with both Dow Corning 500W Additive and Dow Corning 67 Additive.

**THE AGE-OLD PROBLEM OF FOAM CONTROL**

Perhaps the formulator's worst headache, foam control in waterborne systems, is still very much an issue when creating formulations. Dow Corning's range of long lasting silicone foam control additives will aid in foam prevention during manufacturing and end-user application. Their efficiency also means they can be added at very low addition levels and cost-in-use should always be considered. These can come as emulsions or as 100% organo-modified materials depending on the application need.

In figure 6, by adding a Superwetter, an increase in the level of foam in a given formulation can be seen but this is easily controlled by adding a low level of silicone antifoam.

**CONCLUSION**

Silicone additives afford the paint formulator the possibility to solve their most difficult formulating problems. Dow Corning Superwetters are ready to deal with the most difficult wetting issues. Its range of long lasting foam control additives means foam prevention during production and at the customer. But remember – silicone additives can also help differentiate the product from that of the competition and create a sensation that the end-user will see, feel, appreciate and value. Heroic silicone additives have so much to offer, they are truly here to save the day.