Surface treatment and coatings of Paints

Paints are pigmented liquids with decorative and protective properties. The chemical make-up of paints include three components namely, the colouring/ functional agent known as pigment; the adhesive binder that enables cohesion of paint particles and also, binding of paints to desired surface; and the dispersion solvent which makes paints spreadable over the required area. The use of paints primarily is to make surfaces visually appealing. Paints also impart specific properties such as durability, heat resistance, hydrophobicity, etc., to the painted surfaces. The performance of paint substances can be enhanced by either by modifying the paint composition or by surface treatment/ coating of the paint covered areas.

Surface wetting and paints

The formation of an interface between the paint film and the surface on which paint is applied involves the consideration of surface properties of the material. The perceptions of properties such as surface energy, surface tension and contact angle are critical to evaluate the formulation and application of paints. Surface wetting is characterized in terms of the balance between the cohesive forces within the paint molecules and the adhesive forces at the interface. This is primarily influenced by surface energy of the substrate. For example, the low surface energy reduces the adhesion of various paints on polymeric substrates.

The surface wetting property of the paint and or coating is estimated in terms of the contact angle between the liquid and the solid substrate. Measuring the contact angle of the liquid paint indicates its ability to spread on to the solid surface to be coated. The quality and durability of paints is undeniably dependant on the surface tension property of the pain substance. This is because to achieve optimal wetting it is essential to make sure that the surface tension of the paint liquid is relatively lower than the surface energy of the substrate to be coated. Reduced surface tension also aids the visual of the coated film by reducing the formation of defects (scratches, pinholes, etc…) on drying. The nature of the coating (hydrophobic/ hydrophilic) can be evaluated by means of measuring the sliding angle of the coated surface.

What we offer?

Dropletlab introduces dropometer, a smartphone based optical tensiometer to measure the surface properties of materials. The instrument can measure surface energies and tensions up to 100 mN m^{-1}. Contact angle and sliding angle of 0° - 175° can also be measured. The new tensiometer can be used to critically evaluate and optimize the painting or coating process. Typical applications involve:

- Measure surface tension of solid substrates to be coated
- Determine the surface energy of substrate
- Measure contact angle of paints on surfaces
- Measure the surface tension of paints or coating material
- Optimize adhesion between paints and substrate
- Determine the wettability of surfaces for coating
- Measure contact and sliding angle at the contact between paints and surface
- Aid in optimizing surface properties of paint formulations
- Evaluate the surface properties of coated surfaces

Our Industrial Clients

- Avery Dennison Corporation, Glendale, California
- Teledyne FLIR LLC, Wilsonville, Oregon

Some relevant case studies

1. Coating for paintings

The overlaying of distinct coatings to painted surfaces not only aids in refining the surface visual by elimination of defective appearances, but also imparts unique characteristic features to it. Durable super hydrophobic coatings with large contact angle and smaller sliding angles have been largely reported. These coatings applied onto painted surfaces impart specific properties such as self-cleaning, fouling and corrosion resistance, etc., For example, fluorine silica sol based super hydrophobic coatings have been developed for Chinese paintings to preserve the original state of these paintings. The contact angle and sliding angle of the coating was shown to vary between the coloured and colourless segments treated with different reagents[1]

S. No	Fluorine Silica Sol derived from	Segment	Contact Angle	Sliding Angle
1.	1H,1H,2H,2H-perfluorodecyl triethoxysilane	Coloured	151.8	>70
2.	1H,1H,2H,2H-perfluorodecyl triethoxysilane	Colourless	152.4	9.6
3.	1H,1H,2H,2H-perfluorodecyl triethoxysilane + 3-(2, 3-Epoxypropoxy) propyltrimethoxysilane	Coloured	154.2	8.5
4.	1H,1H,2H,2H-perfluorodecyl triethoxysilane + 3-(2, 3-Epoxypropoxy) propyltrimethoxysilane	Colourless	154.0	8.8
5.	1H,1H,2H,2H-perfluorodecyl triethoxysilane + Methyltriethoxysilane	Coloured	150.8	>70
6.	1H,1H,2H,2H-perfluorodecyl triethoxysilane + Methyltriethoxysilane	Colourless	151.2	12.6

[1] 10.1021/acs.langmuir.8b01423