CONCEPT

Hydrophobic and Oleophobic Coatings: Wetting Science, Surface Design and Durability Testing

11 – 15 April 2027
Dammam - Eastern Province five-star



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Ref: 894_21084 **Date:** 11 – 15 April 2027 **Location:** Dammam - Eastern Province five-star **Fees:** 19500 SAR

Introduction:

Solar panels lose output to soiling, heat exchangers foul, antennas ice up and equipment needs constant cleaning because surfaces wet too easily and repellent films wear out within months. Hydrophobic and oleophobic coatings can cut these losses only when surface chemistry, texture, fabrication route and test method are chosen together. This Core Concept course takes engineers from surface energy and Wenzel and Cassie wetting states through fluorinated and fluorine-free chemistries, nano-texturing, deposition, contact angle metrology and abrasion durability. Participants produce a Repellent Coating Selection and Test Plan for a case application.

Course Objectives:

- Calculate apparent contact angles for textured surfaces with the Wenzel and Cassie-Baxter models and predict droplet mobility from hysteresis
- Design superhydrophobic and superoleophobic surfaces by combining low surface energy chemistry with hierarchical and re-entrant texture
- Select fluoropolymer, fluoroalkyl silane, siloxane or fluorine-free repellent chemistries for a given substrate, liquid and service condition
- Specify sol-gel, spray, vapour deposition, plasma or etching routes and judge their scale-up cost and cure constraints
- Measure static, advancing, receding and sliding angles and run abrasion, UV and chemical durability tests with defined pass criteria
- Produce a repellent coating selection and test plan for an anti-icing, anti-soiling, anti-fouling or oil-water separation application

Target Audience:

- Materials engineers who choose surface treatments and substrates for new and modified equipment
- Coatings technologists who formulate, apply and qualify functional surface films
- R&D scientists who develop and characterise water and oil repellent surfaces
- Maintenance engineers who fight fouling, icing and soiling on operating plant and facilities
- Laboratory specialists who run wettability, weathering and abrasion test programmes
- Product development engineers who translate laboratory surface results into manufacturable parts

Course Outline:

Day 1: Surface Energy, Wetting Regimes and Repellency Baseline

- Young Equation Balance of Solid Surface Energy and Liquid Surface Tension
- Hydrophobic, Superhydrophobic, Oleophobic and Omniphobic Wetting Regimes Compared
- Advancing and Receding Angles, Contact Angle Hysteresis and Droplet Roll-Off
- Lotus Leaf Papillae and Epicuticular Wax as a Hierarchical Design Template
- Wettability Baseline Audit of Fouling, Icing and Soiling Problems on Site Surfaces

Day 2: Texture Models, Low-Energy Chemistries and Repellent Architecture

- Wenzel Roughness Factor and Cassie-Baxter Solid Fraction Calculations
- Cassie-to-Wenzel Transition, Impalement Pressure and Re-Entrant Overhang Geometry
- Fluoropolymer and Fluoroalkyl Silane Chemistries for Oil Repellency
- Silane, Siloxane and Polydimethylsiloxane Hydrophobising Agents
- Fluorine-Free Options: Hydrocarbon Waxes, Silicone Brushes and Liquid-Infused Slippery Surfaces

Day 3: Fabrication Routes and Wettability Metrology

- Sol-Gel Silica and Hybrid Organic-Inorganic Film Formulation
- Spray Deposition of Silica Nanoparticle Suspensions With Binder Selection
- Chemical Vapour Deposition, Plasma Fluorination and Plasma Polymer Films
- Chemical Etching and Laser Texturing for Micro and Nano Roughness
- Sessile Drop Goniometry, Tilting Plate Sliding Angle and Wilhelmy Plate Methods

Day 4: Durability Loss, Service Trade-Offs and Fluorochemical Concerns

- Rotary and Linear Abrasion, Tape Peel and Sand Impact Durability Protocols
- UV Weathering, Chemical Immersion and Hydrolytic Breakdown of Repellent Films
- Anti-Icing, Anti-Fouling and Dropwise Condensation Performance Trade-Offs
- Repellent Topcoats Over Anti-Corrosion Primers and Easy-Clean Equipment Surfaces
- PFAS Persistence, Long-Chain Phase-Outs and Fluorine-Free Substitution Screening

Day 5: Case Application Coating Selection and Test Plan

- Case Briefs: Solar Panel Soiling, Self-Cleaning Facade Glass and Oil-Water Separation Mesh
- Candidate Screening Matrix by Chemistry, Texture, Deposition Route and Substrate
- Scale-Up Economics: Application Method, Cure Window and Cost per Square Metre
- Wettability and Durability Test Plan Build With Acceptance Thresholds
- Repellent Coating Selection and Test Plan Defence Before a Technical Review Panel

Skills You Will Gain:

- Wetting Model Calculation
- Superhydrophobic Surface Design
- Repellent Chemistry Selection
- Nano-Texture Fabrication
- Contact Angle Metrology
- Repellent Film Durability Testing
- Fluorochemical Substitution Assessment
- Functional Coating Scale-Up Costing

Why Attend This Course:

- Leave with a Repellent Coating Selection and Test Plan defended before a technical review panel
- Stop buying water repellent treatments that pass a single static drop test and then fail in the first season of abrasion and sunlight
- Prepare for tightening limits on fluorinated chemicals with a screened shortlist of fluorine-free options
- Compare repellent surface problems with peers from energy, water, manufacturing, construction glazing and process plants

Conclusion:

Repellent surfaces work in service when chemistry, texture and deposition are matched to the liquid, the substrate and the wear they will face. The course moves from surface energy, wetting regimes and hysteresis, through Wenzel and Cassie models, fluorinated, siloxane and fluorine-free chemistries, to sol-gel, spray, vapour, plasma and etching routes and contact angle metrology, then abrasion, UV and chemical durability, application trade-offs and fluorochemical concerns. The final day produces a coating selection and test plan for a case application.