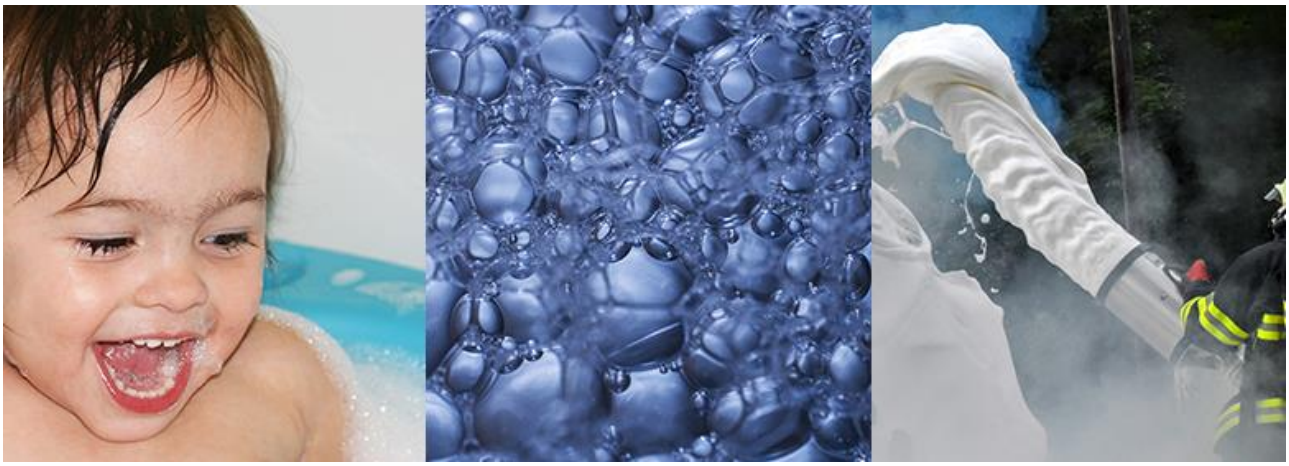

# Course:

# Bubble and Foam Chemistry

*18-19 September 2019*

Location: RISE, Drottning Kristinas väg 45, Stockholm, Sweden

## Lectures:

**Foam structures and types of foams**
- Wetness and dryness of foam
- Capillary pressure and Laplace/ Young equations
- Foam structures from bubbles with narrow particle size distribution
- Surface active agents, surface tension and Gibbs elasticity
- Foamability and foam stability

**Chemical foaming surfactants**
- Foaming surfactants, solubility and Kraft point
- Surfactant critical packing parameter
- Weakly hydrolysable fatty acids
- Influence of CMC, structure and HLB on foaming

**Processes in foaming**
- Bubbles ascending in liquids
- Drainage of liquid
- Disproportionation (Oswald's ripening)
- Coupling of drainage with disproportionation
- Depletion of surfactant from solution
- Humidity and evaporation

**Generation of bubbles and foams**
• Adsorption of surfactant on fresh bubbles
• Different types of foam generation methods
• Mechanical methods
• Growing bubbles from orifices and frits
• Nucleation of gas bubbles
• Generation of bubbles by electrolysis

**Coalescence of bubbles**
• Formation, break-up and coalescence processes
• Role of surface tension gradients
• Elasticity and critical transition concentrations
• Experimental studies on bubble coalescence
• Studies in inorganic electrolytes
• Influence of bubble velocity and temperature

**Stability/instability of foams**
• Kinetic classifications of stability
• Reversing the stability
• Gibbs/Marangoni stabilization effect
• Interfacial rheology
• Stability by chemical control agents
• Stability by increase in bulk viscosity
• Stability in aerated food foams
• Stability by adding emulsions

**Bubble size measurements and foam test methods**
• 2D imaging, optical fibre probes, X-ray, tomographic imaging, back scattering
• Measurements on bubbly liquids and foams
• Whipping, shaking, Ross Miles, Bikerman tests
• Electical conductivity, Foam Scan, Comparison of different techniques
• Measurement of antifoam efficiency

**Non-Aqueous foams**
• Hydrocarbon, polymethyl siloxanes and fluoroalkyl type surfactants
• Phase separation in partially immiscible liquis
• Lamellar liquid crystals
• Bulk viscosity effects
• Inorganic electrolytes in non-aqueous liquids

**Particle stabilized foams**
• Fundamentals, attachment of bubbles to particles
• Interaction between neighbouring particles attached to bubbles
• Steric barriers
• Contact angles and hydrophobicity
• Influence of particle charge, concentration size and state of agglomeration
• Particle/surfactant and particle/polymer mixtures
• Diffusive disproportionation and bubble shrinkage effects

**Thin films and model systems**
• Early studies and experiments with free horizontal circular films
• Scheldudko/Exerwa film cells
• Porous plug technique
• Nikolov/Wasan cells
• Film drainage
• Disjoining pressures repulsion
• Intermolecular forces
• Physical chemistry of black films
• Film rupture

**Defoaming and antifoaming**
• Physical and chemical mechanisms
• Micellar aggregates, particles, cloud point defoamers, particle/oil mixtures
• Theories of slow and fast antifoam action
• Influence of surface hydrophobicity of particle
• Ageing effects of chemical antifoamers
• Physical methods of antifoaming

**New areas of foam developments**
• Metal and material foams.
• Particle stabilized foams at high temperatures
• Foams produced in nature and bio-surfactants

**Practical/Demo Session**
• Ross Miles test, Bikerman test, Dynamic Foam Analyser
• Bubble size distribution and stability assessment

*The course program also includes a shorter tour of the laboratory facilities of RISE. The tour is an opportunity to see and learn more about a couple of research instruments relevant to the topics of the course.*