NANO-EMULSIONS AND MICRO-EMULSIONS

November 14–15, 2012
Malmö – Sweden

The Öresund bridge, Malmö–Copenhagen

CALMIA
EDUCATION CENTER

NANO-EMULSIONS AND MICRO-EMULSIONS

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This course is held for the 12th time.

Course Outline

NANOEMULSIONS – Day 1

Introduction
Definition of nanoemulsions and the reason for their long term kinetic (physical) stability. Attraction of nanoemulsions for application in personal care products and cosmetics, healthcare products, pharmaceuticals and agrochemicals.

Mechanism of emulsification
Role of interfacial energy – explanation of the high energy required for formation of nanoemulsions – the Laplace pressure concept – role of surfactants – assessment of the emulsion quality.

Methods of emulsification
Pipe flow, static mixers and general stirrers, high-speed mixers, colloid mills and high pressure homogenizers – continuous and batch-wise preparations – turbulent flow.

Role of surfactants
Reduction in interfacial tension and the effect on droplet size. The Gibbs adsorption equation. Interfacial dilational modulus. Role of surfactants in droplet deformation. Interfacial tension gradients and the Marangoni effect. Comparison of various emulsification techniques.

Preparation of nanoemulsions
High pressure homogenization and efficiency of preparation. The Phase Inversion Temperature (PIT) principle. Variation of interfacial tension with temperature. Phase diagrams as a function of temperature.

Steric stabilization and the role of the adsorbed layer thickness
Unfavourable mixing of the stabilizing chains, entropic repulsion. Total energy – distance curves for sterically stabilized emulsions. Variation of the energy curve with the ratio of adsorbed layer thickness to droplet radius.

Ostwald ripening
Driving force for Ostwald ripening. Theory of Ostwald ripening and determination of the Ostwald ripening rate. Reduction of Ostwald ripening by incorporation of highly insoluble oils. Use of polymeric surfactants for reduction of Ostwald ripening.

Practical examples of nanoemulsions
Nano-emulsions based on nonionic surfactants. Comparison between the phase inversion technique and use of high pressure homogenizers. Nanoemulsions prepared using polymeric surfactants. Influence of oil polariy and methods of reduction of Ostwald ripening rate.

MICROEMULSIONS – Day 2

Introduction
Discovery of microemulsions and schematic representation of oil/water and water/oil microemulsions. Comparison with micelles and macroemulsions. Driving force for their thermodynamic stability and definition.

Mixed film and solubilization theories of microemulsions
Concept of a duplex film and bending of the interface to form o/w or w/o microemulsions. Phase diagrams of ternary systems of water, surfactant and cosurfactant. Concept of normal and inverse micelles. Quarternary phase diagrams of oil/water surfactant and cosurfactant. Solubilization of oil by nonionic surfactants and the effect of temperature.

Thermodynamic theory of microemulsion formulation and stability
Reason for combining surfactant and cosurfactant to produce an ultra low interfacial tension. Formation of a model w/o microemulsion using 4 steps. Relationship of droplet size to interfacial tension, w/o versus o/w microemulsions.

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Characterization of microemulsions using scattering techniques

Time average light scattering, Neutron scattering, Quasi-elastic light scattering (Photon Correlation Spectroscopy, PCS).

Characterization of microemulsions using conductivity and NMR

Conductivity of water/oil microemulsions, percolating and non-percolating microemulsions. Bicontinuous microemulsions, viscosity of microemulsions. NMR technique for measurement of self diffusion of all components in microemulsions and explanation of the various structures.

Formulation of microemulsions

General procedure of formulation of microemulsions. Selection of microemulsions based on:
The Hydrophilic Lipophilic Balance (HLB) concept, The Phase Inversion Temperature (PIT) concept and the Cohesive Energy Ratio (CER) concept.

Course description

Nanoemulsions that cover the size range of 50–200 nm are kinetically stable systems with long term physical stability (against creaming or sedimentation, flocculation and coalescence). Microemulsions, on the other hand, are thermodynamically stable systems (usually in the size range of 5-50 nm). Both systems have attracted considerable attention in recent years for application in personal care and health products, cosmetics, foods, pharmaceuticals, agrochemicals, household products, paints, coatings and the oil industry.

Nanoemulsions are easily formulated using high-pressure homogenizers with proper choice of surfactants and/or polymers. Due to their small size they enhance penetration, spreading and will give uniform distribution on the substrate on which they are applied.
In this course, the principles of emulsification and the role of surfactants will be described at a fundamental level. The production of nanoemulsions using high-pressure homogenizers and application of the Phase Inversion Temperature (PIT) principle will be described.

This is followed by the theories of steric stabilization and highlighting the role of adsorbed layer thickness in stabilization of nanoemulsions.

The fourth part will deal with the problem of Ostwald ripening which is the main cause of instability of nanoemulsions. Some examples will be quoted to illustrate the above principles.

The second day of the course will deal with microemulsions, explaining the origin of thermodynamic stability. Theories of microemulsion formation and stability will be given and followed by an explanation of oil/water versus water/oil microemulsions based on the critical packing parameter concept. Characterization of microemulsions will be described using scattering techniques, conductivity, viscosity and NMR. The final part will deal with formulation of microemulsions and the selection of surfactants.

The two day course will be valuable to scientists and engineers involved in the formulation of emulsions.

Course lecturer

Prof. Tharwat Tadros
was formerly a Senior Research Associate at the Zeneca Agrochemicals, Jealott's Hill Research Station (The ICI Group), Bracknell, UK. He is a Visiting Professor at The Bristol University and also works as a consultant and lecturer worldwide.

Prof. Tadros has published over 250 papers in the fields of rheology and dispersions and has edited four books on polymer adsorption and stability, solid/liquid dispersion, surfactants and polymers in disperse systems. Furthermore he is the author of a book on Surfactants in Agrochemicals. And he has written a book on Applied Surfactants (2005).

He also carried out extensive research in the fields of suspensions and emulsions and their rheology. Prof. Tadros is the editor of Colloids and Surfaces Journal, Advances in Colloid and Interface Science and is a past President of the International Association of Colloid Scientists.

Due to his distinguished research Prof. Tadros was awarded two medals from the Royal Society of Chemistry in the UK.

Course Fee and Payment

EUR 1580 (Discounted fee* EUR 1480)

** Discounted Course fee is valid for two or more enrolments from the same company, at the same time, for the same course. And for enrolments from Universities and Government Institutes.*

The course fee includes: Tuition, copies of all Power Point presentations, certificate and meals. Two Lunches, beverages at breaks and course Dinner the first day.

All registrations will be confirmed with a course schedule and some practical information.
We will send an ***Invoice*** to the amount of the Course Fee.
Accommodation is not included in the course fee.
VAT (Moms) will be added for applicants domicile in Sweden.

Course Location and Hotel

The course is held at

Radisson BLU Hotel, Malmö – Sweden
November 14–15, 2012

To obtain the reduced price for accommodation, reservations must be made through Calmia.

Weekday nights
SEK 1575 (about **EUR 157**) for a single or double room per night incl. breakfast and VAT.

Nights between Saturday/Sunday/Monday
SEK 950 (about **EUR 95**) for a single or double room per night incl. breakfast and VAT.

Radisson BLU Hotel
Östergatan 10
211 25 Malmö, Sweden
Tel. +46-40-698 4000
www.radissonblu.com/hotel-malmo

Transport Information

Copenhagen Airport, Kastrup, is the nearest international airport. There are trains running several times each hour (20 min. journey) from Copenhagen Airport to Malmö Central Station. The course location is only 5–10 min. away from the station in Malmö. The airport bus from Malmö Airport, Sturup, stops outside the station in Malmö.

Course Time Table

Registration on Wednesday at 08:30–8:45
The course ends on Thursday about 16:00

How to register

- **On-Line registration**
  www.calmia.se
- **Fax or Mail**
  A Registration Form can be printed from each PDF-file

Registration must be made before October 14, 2012

Substitutions are allowed at any time from the same company or institute.

Cancellation

No refunds will be made for those who do not attend the scheduled course and/or cancel after October 14, 2012.

Questions

For General questions please contact:
Mrs G Tånge-Henderson
calmia@calmia.se
tel/fax: +46-(0)46-211 00 20

For Scientific questions please contact:
Prof. Tharwat Tadros
Tharwat@Tadros.fsnet.co.uk

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Registration Form

Registration before October 14, 2012

Please print!

The number of participants is limited.

I wish to attend the course:

Nanoemulsions and Microemulsions
November 14–15, 2012
Malmö – Sweden

Reserve on my behalf accommodation at the Radisson BLU Hotel in Malmö

From (date) _____ To (date) _____ Number of nights: _____

☐ Single room ☐ Double room ☐ Late arrival (after 18:00)

The hotel bill should be paid directly to Radisson BLU Hotel on the day of departure

Surname _____

Given Name _____

Job Title _____ ☐ Ms ☐ Mr

Company/Institute _____

Address _____

Country _____

Tel/fax _____ E-mail _____

Purchase Order number _____ (If required by your company)

Invoice address if different from the one above:

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