



• the **minispec** TD-NMR Droplet Size Analyzer

Rapid quality-control, process-control, and R&D of emulsion-based products through minispec TD-NMR analyses

- Droplet size distribution in o/w or w/o emulsion
- Non-invasive, no dilution needed
- Bulk measurement of opaque samples
- Quantification of emulsification efficiency
- Emulsion stability kinetics
- Control product rheology
- Design products for selective absorption
- Controlled release of flavor, API
- Optimize color and appearance
- Decelerate chemical deterioration
- Control microbial spoilage

Bruker's versatile and easy-to-use bench-top TD-NMR analyzer is a turn-key solution for rapid Quality/Process control and R&D in emulsion-based product manufacturing. The easy-to-use Bruker the minispec instrument obtains signal from the hydrogen atoms present in the entire sample, irrespective of its color or opacity, in few minutes. The NMR signal is then analyzed to calculate the restricted diffusion of molecules (oil or water) present inside the droplets, and the software provides the droplet size distribution (DSD), both volume fraction and number fraction, as the final output. Hence, it is a direct measure of DSD at molecular level, and is unaffected by flocculation, unlike optical methods.

TD-NMR Advantages

There are a number of alternative techniques available for droplet size measurement in emulsions but they have limitations that make them unsuitable for analysis of various emulsion systems:

Light Microscopy (LM) & Image Analysis (IA) - Small sample size, Time consuming, Distorts droplet shape and size.

Confocal Scanning Microscopy & Image Analysis - Same as LM & IA.

Low-angle Laser Light Scattering - Dilution step disrupts many emulsions, Cannot distinguish droplet and suspended particle, Droplet clusters are estimated as large droplets.

Electrical Sensing - Requires dilution in most cases, Large number of droplets need to be measured individually.

Ultrasound - Signal attenuates drastically for high solid-content samples.

As compared to the above mentioned techniques, TD-NMR based DSD measurements have the following attributes which makes it a powerful tool for emulsion analysis:

- Provides DSD measurement from the whole bulk of relatively large sample size
- The sample color or opacity does not affect the measurement
- Presence of other particles is not misinterpreted as droplets
- Does not require any dilution step or other pre-treatment, prior to measurement
- Wide range of droplet sizes can be quantified
- No human error is involved in the measurement process
- Measurements are fast and highly precise

Measurement capabilities

- Can measure DSD in both oil-in-water and water-in-oil samples
- DSD is measured from the entire 1cc sample
- Maximum achievable gradient strength of 4Tesla/m allows DSD analysis of wide range of droplet sizes starting from as low as 250 nano-meter
- DSD analysis possible even when same molecules are present both within and outside the droplets
- Final result provides the DSD with respect to volume fraction and number, mean and standard deviation
- Measurement can be done at sample temperature between -5°C and +65°C
- Same instrument can be utilized for other analyses like, but not limited to, SFC, crystallization, water mobility, etc.

Where Can I Use?

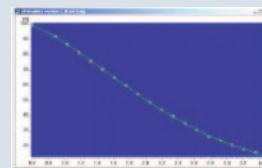
- DSD of o/w or w/o emulsion systems
- Kinetics of emulsion stability
- In-probe dynamic studies on evolution of emulsion characteristics with defined temperature ramping
- Fat crystallization and DSD change in o/w emulsion
- Control product rheology, color/appearance through engineered DSD
- Prediction and control of microbial and chemical spoilage
- Exchange of molecules from within the droplet to outside
- Controlled release of active ingredients (flavor, drug, etc.)
- Design food products with controlled digestibility and caloric output
- Measurement of self-diffusion coefficients of molecules
- Molecular level in-depth study of restricted motion in complex micro-structured materials
- Cosmetic formulation development and performance characterization

Software

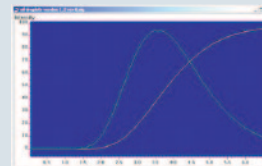
Full programming flexibility through minispec ExpSpel experiment editor for definition of :

- NMR pulse sequences
- NMR data processing
- Customized automation, etc.

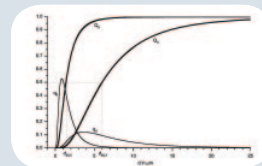
mq-Series systems come with a large application pool, including most widely used and well-established TD-NMR pulse sequences and proprietary droplet size distribution software developed through collaboration with Unilever.



Restricted diffusion data acquired by Bruker the minispec



Droplet size distribution output from Bruker the minispec software



Detailed statistical information generated by Bruker the minispec software (volumetric and population-based droplet size distribution)

Bruker BioSpin
is ISO 9001 certified.

Magnetic safety measures apply to the operation of the minispec.

www.bruker.com ● **Bruker BioSpin**

cmr@bruker-biospin.com