

● the minispec Polymer Applications

Insight into polymer properties by minispec TD-NMR analysis

minispec Key QC/QA Applications in the Polymer Field

- Xylene soluble and ethylene content in PP
- Density and crystallinity in PE
- Oil and rubber content in PS / ABS

Further minispec Examinations

- Cross-link density of elastomers
- Plasticisers, additives and monomer fractions in polymers
- Solid content of emulsions / Latex
- Soft-coatings on polymers
- Oil and water content analysis
- Fluorine content in polymers
- Copolymer analysis, degree of polymerization
- Ageing and irradiation induced effects

Bruker's versatile Polymer analyzers acquire Time Domain-NMR data to determine various physical and chemical properties of polymers.

TD-NMR is a powerful method allowing implementation in all possible production steps:

- Characterization of raw materials / educts
- Kinetics of reactions / polymerizations
- Studies of raw / unmodified polymers
- Examinations on final products / materials

minispec analysis can even be performed in-situ for a wide temperature range from -100 °C up to +200 °C, which is vital for polymer analysis. Typically hydrogen and fluorine containing polymers are analyzed by TD-NMR. The volume examined by minispec can be adapted to the aggregation status of the polymer under investigation.

A variety of NMR parameters is accessible, whether to be used in conjunction with customer-tailored QA/QC analysis or more sophisticated R&D applications. Especially for the latter, more advanced tools for relaxation time or diffusion data treatment are integral part of the minispec software, like chemometric analysis or Inverse Laplace Transformations (CONTIN function).



minispec mq20 polymer Analyzer for a wide range of polymer applications.



the minispec is a versatile tool for QC/QA and R&D on many types of samples; from the crude oil to the final customer product.



For high temperature analysis on polymers, an R&D type minispec with a wide temperature range up to +200 °C is available.

Time Domain-NMR Technology Summary of Advantages

- Analysis is fast, typically a couple of seconds.
- Mostly only few samples (3-5) are required for instrument calibration.
- Classic or chemometric calibration options.
- NMR signal curve fitting routines.
- Repeatability and reproducibility of minispec analysis are significantly better as compared to wet chemical approaches.
- TD-NMR analysis eliminates labour-intensive and time-consuming traditional chemical methods.
- The minispec analyzer is simple to operate, even by floor personnel.
- Versatile approach: minispec systems can be used for various applications, not just for a single method.
- Samples can be either liquid, powder, pellet, film or plate; all forms are suitable to be analysed with the minispec.
- Analysis is non-invasive, non-destructive, so measurement can be repeated as often as desired.
- Depending on sample homogeneity, the minispec measurement volume can be matched.
- As the NMR signal is generated by all protons within the entire sample volume, the result does not depend on sample surface or sample colour.
- minispec analysis can be automated.
- minispec system is adaptable to LIMS.

the minispec Polymer Analyzer Options

- minispec mq-one Analyzer for dedicated QC/QA applications.
- minispec mq-series (e.g. mq20) for QC/QA and R&D.

the minispec mq-Series Options

Sample Temperature Control

- Fixed temperature: Sample chamber is regulated by magnet temperature, i.e. probe temperature from 35 °C to 45 °C.
- Variable temperature by external heating / cooling water bath, ranging from -5 °C to +65 °C.
- Wide-range variable temperature using gas flow system from -100 °C to +200 °C.

RF Pulse Options

The minispec can be configured for RF pulse attenuation and / or RF pulse shapes for demanding applications, e.g. $T_{1\rho}$ experiments.

Pulsed Field Gradients & Diffusion Analysis

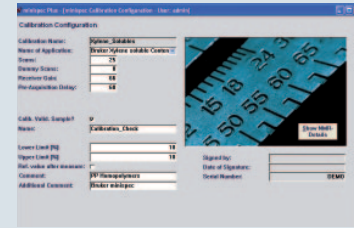
Extend your mq-system for gradient applications. Retrofittable probes and dedicated systems are available.

minispec ProFiler

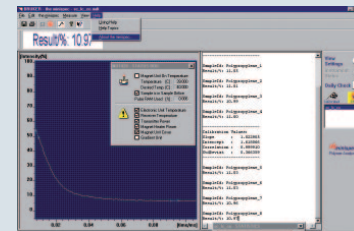
The minispec ProFiler is a single-sided NMR device perfectly tailored to industrial requirements. Taking the spectrometer to the sample (like a car tire), the ProFiler allows relaxation time analysis at various measurement depths.

the minispec Software Options:

minispec Plus software for mq-one, adapted to dedicated Polymer applications:



Standard Software for Advanced Polymer Analyzers:



Example above: Rubber in Polystyrene / ABS polymer.

Feature Extract of Standard Software:

Full programming flexibility by minispec ExpSpel experiment editor for definition of

- NMR pulse sequences
- NMR data processing etc.

mq-series systems come along with a large application pool, including almost all common TD-NMR pulse sequences.

Alternative Software Options:

- minispec Plus Software for classic application with calibration.
- minispec Plus Software for chemometric data analysis.
- minispec Plus Software for relaxation time analysis with simultaneous control of BVT3000 tempering unit, e.g. for temperature ramps or pre-defined temperature profiles.

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www.bruker.com ● **Bruker BioSpin**

cmr@bruker-biospin.com