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NMR for Quality and Process Control of Polymer Products

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NMR (Nuclear Magnetic Resonance) is known in Medicine as an imaging method and in Chemistry as a method for analysis of molecular structures. The objects of interest are brought to the instruments for analysis inside the homogeneous region of a large magnet. Less known is the use of mobile NMR sensors which are positioned at a particular spot on the object for analysis. For example, the walls of boreholes are analysed in oil fields for their hydrocarbon contents with such unilateral sensors. Unilateral NMR is also used for non-destructive materials analysis. It is commercially established to characterize elastomer products in terms of cross-link density, vulcanisation, and aging. Recently it has been shown, that poly-olefine products like semi-crystalline polyethylene can be characterized with the same technology in terms of their crystallinity and properties of the amorphous domains. A measurement with the so-called NMR-MOUSE® (MObile Universal Surface Explorer) requires about three minutes and can be conducted at selected depth up to 10 mm. Furthermore, moisture profiles can be determined high resolution (30 μm) even at low moisture content (1 %). As the device is mobile and the measurement is non-destructive, the method is suitable for product and process control.