Rubber consists of long and flexible macromolecules, which are physically entangled. During processing, raw rubber is mixed with fillers and processing agents, and usually sulfur following the formulation oft the manufacturer. The raw product is vulcanized at elevated temperature and pressure where the sulfur forms cross-links between the macromolecules. The resulting rubber network derives its physical properties from the type of polymer, the polymer-filler interactions and the cross-link density. Rubber tubes, conveyor belts and tires consist of several layers of rubber with different properties and often fiber and steel belts to provide extra strength. The cross-link density correlates with the transverse NMR relaxation time $T_2$, which can be estimated with the NMR-MOUSE at different positions and depths in the intermediate and final rubber products. Depth profiles through tires can also be measured with the NMR-MOUSE and reveal the succession and properties of the different rubber layers. The type and quality of raw rubber can be controlled with a Spinsolve spectrometer by $^1$H NMR spectroscopy of the raw product dissolved in a solvent like chloroform.
Figure 2: Depth profiling with the NMR-MOUSE. Left: Photograph of the NMR-MOUSE PM25 measuring a depth profile through a winter tire mounted on a steel rim. Right, top: Depth profile through the tire tread. The amplitude is a relaxation weighted proton density corresponding to the grey scale in a magnetic resonance image. The depth scale is distorted by the presence of the steel belt. The signal decays at positions A and B differ in their amplitudes as well as in their decays corresponding to different $T_{2eff}$.

Figure 3: Spinsolve $^1$H NMR spectra of rubber dissolved in deuterated chloroform without (top) and with (bottom) magnification. Left: NR from different plantations. Middle: Comparison of emulsion and solution SBR. Right: Comparison of emulsion SBR from three different manufacturers.

CONTACT INFORMATION
For further information, please contact: sales@magritek.com

GERMANY
Philipsstraße 8
52068 Aachen, Germany
Tel: +49 (241) 70525-6000
Fax: +49 (241) 9278-6939
Or visit our website www.magritek.com

NEW ZEALAND
32 Salamanca Road
Wellington 6012, NZ
Tel: +64 4 920 7671
Fax: +64 4 471 4665

UNITED STATES
6440 Lusk Blvd., Suite 108
San Diego, CA 92121
Tel: (855) 667-6835
(855) NMR-MTEK