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Filler Gel and Rubber Gel in Silica Filled Rubber Systems

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An examination was carried out on the quantitative analyses of bound rubber in silica-filled rubber systems by a thermal gravimetric analyzer, transmission electron microscopy and pulsed NMR. The bound rubber in solution mixed composites was primarily composed of filler gel which corresponded to the entrapped rubber phase in the agglomerate of silica particles. The amounts were well correlated with the averaged size of the agglomerate (Sagg) in the composites. The size was greatly affected by the surface chemistry of silica particles. The Sagg for mechanically mixed composites was 10^{-1} to 10^{-2} of Sagg for solution mixed composites. Thus, most of the bound rubbers in the mechanically mixed composites were composed of rubber gel which corresponded to the chemically cross-linked rubber phase in the composites. The content of rubber gel was dependent on the sort of silica and mixing conditions. The difference of segmental mobility between filler gel and rubber gel was detected by pulsed NMR. The mobility was higher for rubber gel than for filler gel.