Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Dynamics of Internal Stresses and Scaling of Strain Recovery in Aging Colloidal Gels AJAY SINGH NEGI, CHINEDUM OSUJI, Department of Chemical Engineering, Yale University — On cessation of flow, dilute suspensions of carbon black particles undergo rapid gelation and display instantaneous residual or internal stresses which relax slowly with time. We monitor the evolution of these stresses (under zero strain) and find a weak power law decay, $\sigma_i \sim t_w^{\alpha}$ over 5 decades of time where $\alpha \approx 0.1$. The system exhibits aging, with the elastic modulus scaling as a weak power law of elapsed time, G'$\sim t^{\beta}$, with $\beta \approx \alpha$. Imposition of zero stress conditions after waiting time t_w, at internal stress $\sigma_i(t_w)$, results in strain recovery as the system relaxes without the zero strain constraint. Older systems exhibit less recovery than younger ones. Remarkably, strain recoveries at different t_w can be shifted to construct a single master curve in which the magnitude of the recovery is shifted vertically according to $\sigma_i(t_w)^{-1}$ and horizontally simply with elapsed time. The scaling of the strain recovery with internal stress suggests that the internal stress state is characteristic of the age of the system and of the manner in which the system will continue to evolve. This result has important implications for our understanding of glassy behavior in soft materials.

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Date submitted: 22 Nov 2008 Electronic form version 1.4