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Shear viscosity of suspensions and the glass: Turning power-law divergence into an essential singularity NARENDRA KUMAR, Raman Research Institute, Bangalore 560080, India — Extreme slow dynamics defines approach to the glassy state. At the macroscopic scale, it manifests as a rise of shear viscosity as that state is reached through supercooling. The Vogel-Fulcher (VF) law describes that growth of viscosity. This work derives the VF law. Starting with an expression, due originally to Einstein, for the shear viscosity $\eta(\delta\phi)$ of a liquid having a small fraction $\delta\phi$ by volume of solid particulate matter suspended in it at random, we derive an effective-medium viscosity $\eta(\phi)$ for arbitrary ϕ which is precisely of the Vogel-Fulcher form. An essential point of the derivation is the incorporation of the excluded-volume effect at each turn of the iteration $\phi_{n+1} = \phi_n + \delta\phi$. The model is frankly mechanical, but applicable directly to soft matter like a dense suspension of microspheres in a liquid as function of the number density. Extension to a glass forming supercooled liquid is plausible.

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