

Abstract Submitted
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An immersed boundary method for investigating the rheology of heavy crude oil¹ MOHSEN DAGHOOGHI, IMAN BORAZJANI, University at Buffalo — Heavy crude oil is a colloidal suspension of aggregates of many compounds (resins and asphaltenes), which give rise to very unusual rheological properties such as non-Newtonian behavior and very high viscosity. To optimize processes to lower viscosity and improve flow properties of heavy crude oil, a better understanding of the relationship between micro-structure and macro rheological behavior is required. To date, this relationship has been investigated mostly using theoretical models with many simplifying assumptions on the shape, size, and concentration of aggregates that limit their validity and use. We extend our immersed boundary method to simulate arbitrarily shaped suspensions of particles and calculate the viscosity of the suspension. We validate our method against the classical analytical and experimental results for the low Reynolds-Stokes problem of particle suspensions based on the work of Einstein, Batchelor, and others. We apply our method to simulate colloidal suspensions of asphaltenes with their experimentally observed micro-structure. We investigate the effects of asphaltene aggregates' concentration, size, shape, and polydispersity (different aggregate sizes) on the viscosity of the heavy crude oil.

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