Advanced and New Problems in Fluid Mechanics

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Colloidal coal in water suspensions

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Abstract

We discuss the possible clean coal applications of colloidal suspensions of coal in water (CCW) that we manufacture with a wet-comminution device based on fluid dynamics. These suspensions are a new material with new properties. First, the colloidal fraction plus water is a pseudo fluid good for transport, handling and suspension of large particles. Second, the surface area per unit volume of coal available for chemical reaction and burning is greatly increased and finally, CCW may be milled with a third fluid, seeding the mixture with submicron coal.

The colloidal nature of the majority of particles provides for very good features such as outstanding long-term stability, in contrast to regular coal water slurries (CWS) which rapidly sediment under storage. Moreover, the very small particles create an increased reactivity to combustion because small particles with large surface area react faster than large particles with the same volume.

Spontaneous dispersion of particles on liquid surfaces

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Abstract

When small particles, e.g., flour, pollen, etc., come in contact with a liquid surface they immediately disperse. The dispersion can be explosive, especially for small particles on the surface of mobile liquids like water. This is due to the fact that the capillary force pulls particles into the interface causing them to accelerate to a relatively *large* velocity. The maximum velocity increases with decreasing particle size; for nanometer sized particles, e.g., viruses and proteins, the velocity on an air-water interface can be as large as ~47 m/s. We also show that particles oscillate at a relatively high frequency about their floating equilibrium before coming to stop under viscous drag. The observed dispersion is a result of strong *repulsive* hydrodynamic forces that arise because these oscillations.