

Some Recent Developments in Surfactant Drag Reduction

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Abstract

The turbulent drag reduction phenomenon has been known for more than fifty years. Early research and development studies focused on high polymer drag reduction which is widely utilized in pipeline transport of hydrocarbon liquids such as crude oil. However, high polymer drag reducing additives degrade irreversibly when subjected to shear, such as in passing through a pump, and therefore they are only suitable for “once-through” systems. In the past fifteen years, drag reduction research emphasis has shifted to surfactant drag reduction because of the “repairable” nature of these systems after mechanical degradation which permits them to be used in recirculation systems such as district heating and district cooling systems.

Some surprising behaviors of cationic surfactant drag reducing systems will be described such as a new lower limiting friction factor asymptote for surfactant systems, a new (steeper) limiting mean velocity profile asymptote for surfactant systems, turbulence intensity and Reynolds stress measurements, the influence of chemical structure of counterion molecules on drag reduction and rheology, and the influence of shear on surfactant microstructure by cryo-TEM (cryogenic Transmission Electron Microscopy).