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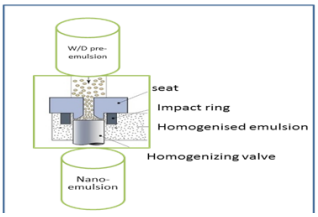
Water-in-diesel fuel nanoemulsions: Preparation using high-energy emulsification method, stability and physical properties

Jyotsna Waghmare and S Mane
Institute of Chemical Technology, India



The aim of this research is to develop alternative fuel system i.e. water in diesel nanoemulsion with reduced exhaust emissions, reduced cost, increased transportability (due to increased flash point) and increased efficiency of diesel engine. The effect of surfactant concentration and HLB value on stability of emulsion is studied by preparing the emulsions with varying composition of fuel blends within HLB range of 1.8-10.6. The main focus of this study is to enhance the stability, transparency by selecting optimum proportion of emulsifier, water and fuel constituents. Emulsion stability was further enhanced by using suitable co-surfactants with proper concentration. Fuel properties (such as density, viscosity, flash point, pour point, stability) of the selected blends were examined and compared to those of conventional diesel. In comparison with diesel, increases in viscosity, density and flash point were observed. Most important thing to be noted is that, our nanoemulsion system is found to stable for more than 180 days with mean droplet diameter 106.7 nm and polydispersity index is 0.195. Nanoemulsions are transparent or translucent systems with water droplet size in the range of 50 to 200 nm. According to literature, nanoemulsion can be prepared either by high energy method or by low-energy method of emulsification. The role of surfactant is very crucial in emulsion. We have prepared nanoemulsion by high pressure homogenizer. Water in diesel emulsion system with emulsifier at 6% concentration forms the most stable emulsion (EF 8) which has 9% aqueous phase. Among all single and mixed (Span and Tween) surfactant/co-surfactant systems a blend of Span 80: Tween 80: n-butanol: 1-octanol was able to form the most stable water in diesel emulsion. In this blend n-butanol and 1-octanol act as co-surfactant. No phase separation was observed of this finalized system (EF 8) up to 180 days. EF 8 has droplet size of 106.7 nm and polydispersity index 0.195. This proves once again that a mixture of low HLB surfactant and high HLB surfactant gives better emulsion stability and emulsion stability can be further enhanced by using suitable co-surfactants with proper concentration.

Recent Publications

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2. Landfester K, J Eisenblätter and R Rothe (2004) Preparation of polymerizable miniemulsions by ultrasonication. *JCT Research;* 1(1): 65-68.
3. Forgiarini A, J Esquena, C González and C Solans (2001) Formation and stability of nano-emulsions in mixed nonionic surfactant systems. In: *Trends in Colloid and Interface Science XV*. Springer: pp: 184-189.
4. Liu W, D Sun, C Li, Q Liu and J Xu (2006) Formation and stability of paraffin oil-in-water nano-emulsions prepared by the emulsion inversion point method. *Journal of Colloid and Interface Science*; 303(2): 557-563.
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Biography

Jyotsna Waghmare is an Associate Professor in Institute of Chemical Technology Mumbai, India. She is an expert in oils, oleochemicals, surfactants, nutraceuticals and biofuel. She is working in this area since last 15 years.

Jyotsna.waghmare@gmail.com