Synergistic foaming properties of lauroyl ethyl arginate and cellulose nanocrystals

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ABSTRACT

We investigated foamability and foam stability in mixtures of cationic surfactant, lauroyl ethyl arginate (LAE) and cellulose nanocrystals (CNC) with sulfate and carboxylic functional groups. We showed that no stable foam was formed at low surfactant concentrations, but at the addition of a very small amount of anisotropic CNC (less than 0.5% wt.) foams with a half-life exceeding 4 hours could be obtained.

Stability of foams laden by cellulose nanocrystals with sulfate groups stongly depended on LAE concentration with clear maxima of surfactant adsorption kinetics and the value of surface dilatational modulus. The formation of CNC aggregates at the interface induced large values of shear elastic modulus. The interfacial rheological and foaming properties were improving only up to LAE concentration above which bulk CNC aggregates decreased surfactant adsorption and acted as defoamers.C ellulose nanocrystals with carboxylic groups enhanced adsorption properties to a greater extent in the same stoichiometry than sulfate-CNC. Foamability in such dispersions was two times higher. The aggregation point of CNC at pH7 was shifted to much higher LAE concentrations, as indicated by the dynamic light scattering measurements. Drainage in foam columns was dependent on the pH of LAE – CNC dispersion. At pH 4, high liquid content was maintained, and the highest foam stability was observed in the synergistic LAE-CNC mixture. At pH 10, the enhanced adsorption of partly deprotonated surfactant provided excellent foamability but fast drainage led to much lower liquid content in the foam. No significant reduction of foam stability was observed at high pH value.We believe that so different drainage behaviour of LAE-CNC mixtures but with similar foamability and foam stability could be explained by the interplay of electrostatic interactions and structural stabilisation of foams by cellulose nanocrystals.

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