The Effect of Chain Length Compatibility on Molecular Area, Intermolecular Spacing, Dispersion Energies and Evaporation Resistance of Mixed Monolayers

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Oberflächenerscheinungen

Using mixed monolayers of alkyl alcohols, it was established that the unequal chain lengths cause an expansion in the area/molecule in mixed monolayers. Assuming the cross-sectional area of molecules to be circles, it was shown that a difference of two methylene groups between the two components of the mixed monolayer causes an increase in the intermolecular spacing of about 0.05 Å. The small increase in intermolecular spacing strikingly decreases the resistance of mixed monolayers to evaporation of water. The surface viscosity was found to be maximum when the chain-lengths of the components were equal. The dispersion energy between alcohol molecules in the mixed monolayer was calculated using Salem's approach. It was found that a small increase in intermolecular spacing ($\simeq 0.05$ Å) can decrease the dispersion energy by 6.7 kJ mol. The magnitude of this decrease is about 1/4 of the energy of a hydrogen bond. It was further shown that the small increase in intermolecular spacing decreases the melting point of mixed crystals by about 9 °C. The chainlength compatibility of mixed surfactants also influences the bubble size, bubble stability, emulsion stability, lubrication, contact angle and wettability. In summary, using the monolayer approach, it was experimentally shown that a small change of 0.05 Å in intermolecular spacing brought about by a difference of 2 methylene groups between the two surfactant molecules, can strikingly influence the dispersion energy between the molecules. The small change in dispersion energy influences the characteristics of many engineering processes such as bubbles, foams, emulsions, lubrication and wettability.