

DIFFERENTIAL SCANNING CALORIMETRY OF TERNARY SYSTEMS AND O/W CREAMS STABILISED BY CETRIMIDE/FATTY ALCOHOL MIXED EMULSIFIERS

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Previous studies indicated that homologue composition of fatty alcohols can markedly affect the consistencies and stabilities of o/w emulsions prepared with ionic and non-ionic surfactants (Eccleston 1976, 1979). Creams prepared with pure cetyl or stearyl alcohols were less stable than those prepared with commercial cetostearyl alcohol. Emulsion stability was related to the type of continuous phase formed when excess mixed emulsifier interacted with water. The present work reports the use of Differential Scanning Calorimetry (D.S.C.) to investigate phase transitions in both stable and unstable fatty alcohol emulsions. Ternary systems, formed by interacting cetrimide and each fatty alcohol in water, and chosen to represent the type of continuous phases present in the corresponding emulsions, were also investigated. Stability was followed using rheological methods.

Liquid paraffin-in-water creams stabilised by cetrimide and alcohols cetostearyl B.P. or pure cetyl or stearyl and ternary systems, formed by dispersing appropriate quantities of each fatty alcohol and surfactant in water were prepared by a standardised procedure. The systems were examined as they aged over 30 days microscopically, rheologically (Ferranti-Shirley cone-and-plate viscometer) and using D.S.C. between 15-100°. (Du Pont 910 D.S.C. System with 990 Programmer/recorder).

Each pure alcohol showed a single endothermic peak in D.S.C. at 56° (cetyl) and 63° (stearyl). Two endotherms were observed with cetostearyl alcohol, one broad (peaking at approximately 44°) and one sharp (53°). All ternary systems and emulsions were semisolid immediately after preparation. Thus, as noted in previous work, flow curves obtained at 25°, the storage temperature, were in the form of anticlockwise hysteresis loops and apparent viscosities were high. On storage the cetostearyl alcohol systems remained semisolid and stable, whereas the pure alcohol systems became mobile and emulsions eventually separated. In these unstable systems, flow curves changed and apparent viscosities reduced on ageing.

It is significant that throughout this work, D.S.C. data for each ternary system gave similar transitions to those of the corresponding emulsion. In the stable cetostearyl alcohol ternary system and emulsion, a single, broad transition endotherm was present, beginning near 40° and peaking at 60°. This endotherm did not alter over the 30 day testing period. In contrast, the unstable pure alcohol ternary systems and emulsions gave several endothermic transitions, which changed as systems broke down. For example, the fresh semisolid stearyl alcohol systems showed two major endotherms at approximately 44° (broad) and 65°. As the systems aged and became mobile the 44° endotherm became more prominent as that at 65° reduced. The 65° transition had almost disappeared in the 10 day old (separated) stearyl alcohol emulsion. Similar trends were apparent in the pure cetyl alcohol systems. The endotherm at approx. 43° became larger and that at 60° decreased as systems aged.

The D.S.C. results correlated well with microscopic experiments and previous rheological work. They imply that emulsion continuous phases, formed from the interaction of cetrimide and fatty alcohol in water can exist in several forms, each stable over definite temperature ranges depending on alcohol chain length and homologue composition. A semisolid emulsion will form only when one of these, the viscoelastic gel phase, is stable at storage temperature (25°).

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