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EFFECT OF WATER ON STABILITY OF CARBON BLACK DISPERSED IN NONAQUEOUS AEROSOL OT SOLUTIONS

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Water solubilized in the reversed micelle of Aerosol OT affected markedly the stability of carbon black dispersed in the solution. For the dilute dispersion of carbon black in the fixed concentration of Aerosol OT, the addition of water stabilized electrostatically the dispersion, following massive flocculation and finally recovered stability. The latter stability is due to the formation of network.

Zeta-potentioal(ζ) and the stability of TiO_2 or carbon black dispersed in non-aqueous sodium bis-(2-ethylhexyl) sulfosuccinate(Aerosol OT) solutions are higher at low content of water, but ζ lowers and flocculation occurs with increase of water below 150 mM of water.[1,2] Carbon black dispersion recently awakes much interest as a model system of coal liquefaction or coal and oil mixture.[3] New information that carbon black flocculating in the Aerosol OT solution of modest content of water recovers apparent stability beyond the higher content of water(~1000 mM) and the region is relating to the formation of microemulsion in the medium is described here.

Graphitized carbon black, Sterling MT of the Cabot Co. was washed with water, methanol, acetone and finally cyclohexane. Aerosol OT used as a surfactant was purified by removal of insoluble matter in methanol and extraction of a small quantity of inorganic impurities.[4] Carbon black was dispersed by ultrasonic irradiation in cyclohexane solution of Aerosol OT(20 or 40mM) solubilizing a variety of amount of water and then the sediment behavior was observed. Alternatively, a variety of amount of water was added into carbon black dispersion in dry cyclohexane solution of Aerosol OT. Both systems showed similar sedimentation behavior. Concentration of carbon black was 0.1 wt% through the experiment.

Change of the height of sediment(h) with the concentration of water was shown in Fig. 1 at 6 hr after preparation of dispersions(height of dispersions was 30cm). Particles were well dispersed and the sedimentation rate was very slow over the low concentration range of water(Region A). Flocculation increased with increase of water (Region B) and massive flocs formed successively sedimented rapidly over the water concentration range of 80-500 mM or 200-1050 mM for 20 or 40 mM of Aerosol OT, respectively(Region B'). However, dispersions recovered the stability beyond 900 or 1070 mM of water, respectively(Region C).

Zeta-potential measured in Regions A and B was depicted in Fig. 2 together with the sedimentation curve of Fig. 1. From the comparison of both curves, the stability of the dilute carbon black dispersion in the regions can be elucidated by double layer interaction as described by Parfitt et al.[5] The transition point from the massive flocculation(B') to the latter stable dispersion(C) corresponded with that from the clear solubilization region to the blue translucent region which can be observed in the solubility diagrams of water in Aerosol OT-cyclohexane solutions.[6] The blue translucent state results from the swelling of the reversed micelle of Aerosol OT by solubilization of a large amount of water. The swollen micelle may be also called microemulsion.[7]

The following two facts were observed for the dispersions of Region C. Clear supernatant of sharp borderline appeared from the dispersion after long standing. The stress-strain curve of the dispersion depicted by employing a rheometer(a Haake Rotovisco) showed the faint hysteresis and yield point. It is considered from the results that the stability of the dispersions in the microemulsion(Region C) would be ascribed to the formation of network structure which seems to be very loose because of the low concentration of carbon black(0.1 wt%). The formation of the network structure in the very dilute carbon black dispersion may be due to the weak interaction among Aerosol OT molecules adsorbed on the surfaces of carbon black and microemulsion particles and furthermore the minor content of Aerosol OT and water molecules dissolved in the medium is considered to take part in the interaction.

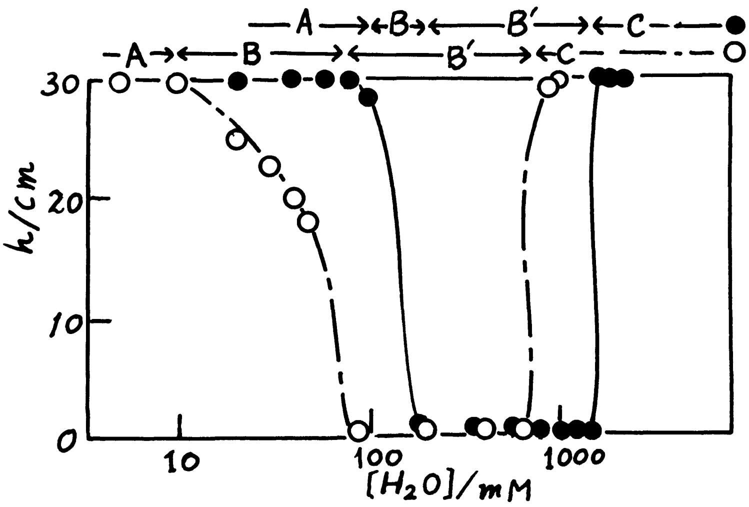

Fig.1. Change of Sediment Height with $[H_2O]$. [Aerosol OT]; ○ :20mM, ● :40mM.

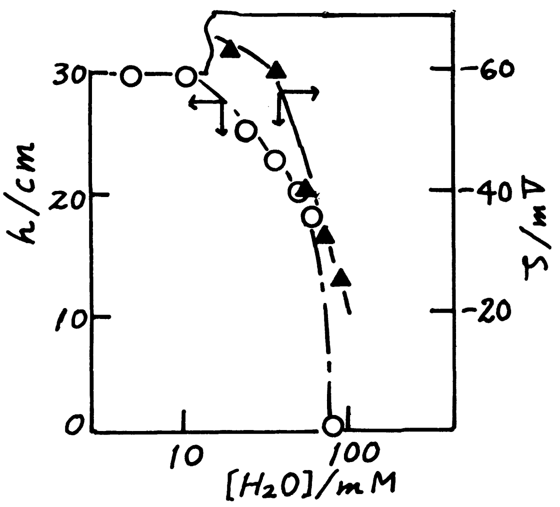

Fig.2. Change of ζ-Potential and Sediment Height with $[H_2O]$ for 20mM of Aerosol OT.

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