Paper converting by polymer particles

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The coalescence of polymer particles, which were larger than those of the polymer latex (below 1 μ), was investigated. And film formation mechanism was discussed.

Polymer particles used were the copolymer of methyl-methacrylate (MMA) and ethylacrylate (EA). They were prepared by suspension polymerization with anionic surfactant and poly-(sodium acrylate) as stabilizer. The particle sizes (L) were controlled by the sorts of surfactants. Particles of two different sizes, average 25 μ and 12 μ, were used. The compositions of the copolymers were as follows: EA/MMA=3/7, 2/8, 1/9, 0/10.

In order to determine the softening temperature (T_s), the tensile strength of films, made from copolymer solution in acetone, were measured at various temperatures. T_s was defined as the temperature at which the yield point in the stress-strain curve disappeared.

These polymer particles were spread on the filter paper and treated at various temperatures. At the temperature of T_1, which is slightly higher than T_s, particles begin to coalesce, but they do not deform and the tensile strength of the treated paper is the same as the original paper. At the temperature of T_2, which is higher than T_1, particles begin to deform and the strength of the treated paper increase. In the case of particles with EA/MMA=3/7, L=25 μ, the following results were obtained.

\[ T_s=50^\circ\text{C}, \quad T_1=60^\circ\text{C}, \quad T_2=120^\circ\text{C}. \]

With decrease of particle size, T_1 is lowered but T_s does not change. When the particles were treated in wet state, T_1 is lower than that in the case of dry state.

It may be assumed that T_1 corresponds to minimum film formation temperature (MFT) of polymer latex and that T_s corresponds to the treating temperature at which latex films have the maximum strength.