

Letter to the Editors

Surface Wettability of Alkyl Methacrylate Polymers and Copolymers

Several workers (1-3, 7) have reported on the relationship between wettability and structure of polymers. Lee suggested (3) that the critical surface tension, γ_c for a copolymer can be calculated by using an empirical equation obtained from the sums of the mole fractions multiplied by γ_c of each homopolymer.

In this work, we evaluated γ_c for a series of copolymer of styrene and methyl methacrylate to determine the effect of copolymer composition. The wettability of poly(phenyl methacrylate) and poly(benzyl methacrylate) was also estimated to evaluate the effects of phenyl groups in side ester.

Styrene-methyl methacrylate copolymers, poly(phenyl methacrylate) and poly(benzyl methacrylate) were prepared by solution polymerization of corresponding monomers in benzene initiated by α, α' -azobisisobutyronitrile at 60°C (4, 5). The composition of

copolymer was determined from the elementary analysis. For the preparation of polymer films, polymer solution was spread on cleaned microscope slides. The solvent was air-dried and then polymer films were annealed. The critical surface tension of these polymer films were estimated by Zisman's method (6) at 20°C. A series of mixtures of water and propylene glycol was used as the wetting liquid. The surface tension of these liquids were checked by the Wilhelmy method.

The results are summarized in Table I. The dependence of γ_c on the copolymer composition is presented in Fig. 1. It was expected that as the content of the styrene unit increased, the contact angles would decrease, approaching the wettability of polystyrene. However, the estimated γ_c for copolymers was little lower than that calculated from the sums of the mole fractions multiplied by γ_c of each homopolymer (3). These differences will be attributed to the effects of different monomer linkage such as A-B in random copolymers.

The critical surface tension of poly(phenyl methacrylate) and poly(benzyl methacrylate) was 35 and 36 dynes/cm, respectively, which are between the γ_c of polystyrene (32 dynes/cm) and poly(methyl methacrylate) (38 dynes/cm). Thus, the replacement of methyl groups by phenyl or benzyl groups in side ester decreased γ_c of methacrylate polymers. In the case of hydrocarbon polymers, however, the introduction of phenyl groups in going from polyethylene to polystyrene

TABLE I

WETTABILITY OF STYRENE-METHYL METHACRYLATE COPOLYMERS, POLY(PHENYL METHACRYLATE) AND POLY(BENZYL METHACRYLATE)

Polymers	Estimated γ_c (dyn/cm)
Poly(methyl methacrylate)	38
Copolymers of styrene and methyl methacrylate (mole % of styrene in copolymer)	
(16.4)	36
(28.3)	35
(36.9)	34
(44.8)	34
(51.7)	34
(59.2)	34
(66.4)	33
(74.5)	33
(88.3)	32
Polystyrene	32
Poly(phenyl methacrylate)	35
Poly(benzyl methacrylate)	36

^a A series of mixtures of water and propylene glycol was used as the wetting liquid.

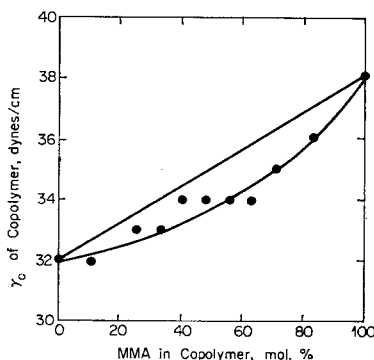


FIG. 1. Dependence of γ_c on copolymer composition.

has been shown to increase γ_c from 31 to 33 dyn/cm (7). These discrepancies will be caused by the fact that that γ_c for poly(methyl methacrylate) is higher than that for polystyrene or for the surface composed of phenyl groups such as the cleavage surface of naphthalene (7). We do not have a good explanation, except that the bulky phenyl group appears to shield the polar carbonyl group in methacrylic acid ester. From this viewpoint, it will be valuable to study the effects of chain configuration on the wettability of polymers.

We will discuss the effects of stereoregularity on the wettability of methacrylate polymers in the near future.

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