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Impact of reference values used for surface free energy determination: an uncertainty analysis

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Abstract

Polar and dispersion surface free energy (SFE) can be determined with the Owens-Wendt method. Thereby, contact angles (CAs) of at least two liquids with known surface tension (ST) components are measured. The ST components can either be determined through experiment or drawn from literature. However, it is important to know how big the difference is between SFE component values that have been calculated with experimentally-determined ST values or values derived from literature. In this study, STs of different test liquids were analyzed by Pendant Drop method and the components by CA measurement on a non-polar surface. CAs on different polymer surfaces were measured to calculate SFE components with the Owens-Wendt method. The calculations conducted were either based on experimentally-determined ST parts or different sets of values found in the literature. The findings of the survey show that, depending on the set of literature values used, the SFE results deviate significantly from the values obtained from experiment. Expressing this deviation in figures, in extreme cases the polar part differs for some polymers by -100% to +100%, with the dispersion component spanning -50% to +43%. In comparison, the expected relative uncertainties exhibited by the experimentally-determined ST values are about 15% for the polar and approximately 5% for the dispersion SFE part. Hence, the results show that the SFE uncertainty can be reduced significantly by means of analyzing the ST parts experimentally.

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