ISGC 2022

N°1218 / PC
TOPIC(s) : Industrial chemistry / Alternative solvents

From petrochemical solvents towards bio-based alternatives: Determination of Hansen Solubility Parameters during the evaporation of complex solvent mixtures in thermoset coating

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PURPOSE OF THE ABSTRACT

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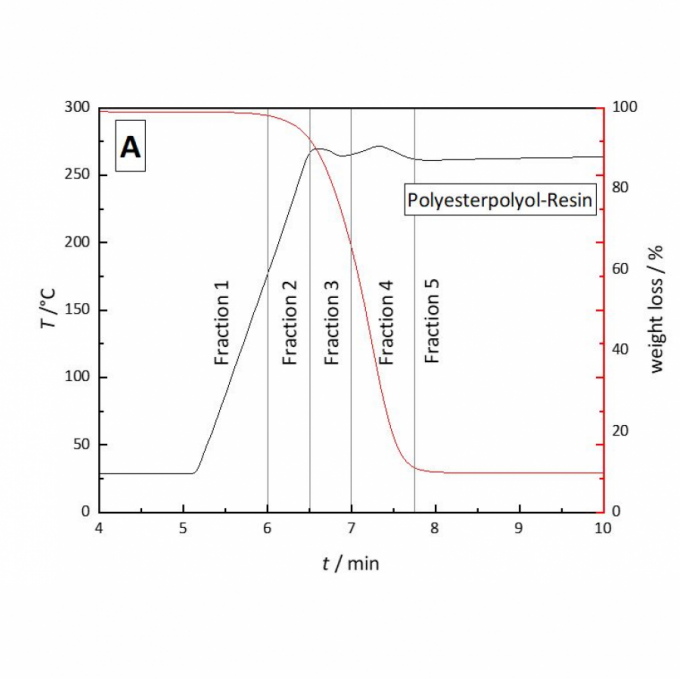
As coated metals are widely employed in household appliances, building or transport industry, the demand and research for more sustainable products and processes is steadily increasing. Evaporation of solvents during the curing of organic coatings has a significant impact on the life cycle assessment of painted metals. An approach to reduce the CO2-footprint, besides the development of novel bio-based coating systems, is the substitution of solvents from petrochemical sources with bio-based alternatives. To achieve this, it is necessary to use bio-based solvent blends with similar solubility and thermo-kinetical properties as their petrochemical counterparts. Hence, Hansen Solubility Parameters (HSP) were used to describe the solubility of resins in complex multi-component solvent mixtures.

To correlate solvency power and thermo-kinetical properties during the evaporation process, 10 wt% Polyesterpolyol-Resin were prepared in a standard mixture of organic solvents and were subsequently analyzed via thermogravimetric analysis (TGA). By fractionated sampling, evaporated substances were adsorbed on TENAX-TA tubes and desorbed via liquid extraction with acetonitrile. The extracted samples were quantified by GC-MS. HSP of upper and lower solubility limits of the Resin dissolutions were determined by solubility experiments and calculated in the program Hansen Solubility Parameters in Practice (HSPiP). HSPiP was also used to determine HSP of the extracted samples.

The results do not only indicate the changes of Hansen Solubility Parameters during evaporation processes, but also show at which weight loss HSP solubility limits are exceeded. Comparing the results from petrochemical mixtures with those from greener bio-based alternatives leads to an efficient substitution and subsequently to an environmentally friendlier process.

FIGURES



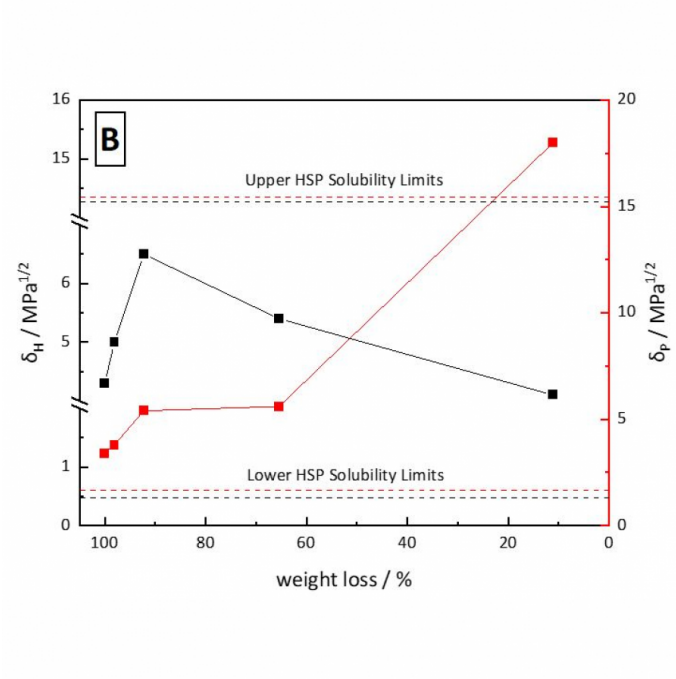


FIGURE 1

Figure 1

a) Fractionated TGA-TENAX-TA analysis of 10 wt% Polyesterpolyol-Resin in a multi-component solvent mixture.

FIGURE 2

Figure 2

b) Calculated Hansen Solubility Parameters (HSP) for dipolar intermolecular forces (P) and h-bonding (H) of the GC-MS analyzed TGA-TENAX-TA fractions and the determined Solubility Limits of the Polyesterpolyol-Resin.

KEYWORDS

thermoset coating | bio-based solvents | hansen solubility parameters

BIBLIOGRAPHY