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Kinetic and thermodynamic analysis of the hydroxyl-terminated polybutadiene binder system by using microcalorimetry

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Highlights

- Microcalorimetry was applied for determining curing kinetics of HTPB binder system.
- The detailed thermokinetics analysis of HTPB-DOS-PAPI binder system was achieved.
- The thermodynamic properties of HTPB-DOS-PAPI binder system was obtained.
- The model function to accurately describe the curing behavior was obtained.

Abstract The isothermal curing kinetics of hydroxyl-terminated polybutadiene (HTPB) binder system containing dioctyl sebacate (DOS) and polyaryl polyisocyanate (PAPI) was investigated by microcalorimetry. The curing was completed after 5.3×10^5 , 4.2×10^5 , 3.6×10^5 , and 3.2×10^5 s at 303.15, 313.15, 323.15, and 333.15 K, respectively. Thus, a shorter time was required to complete curing at a higher temperature. The curing reaction was exothermic, and temperature had minimal effect on the values of the total reaction heat within the testing temperatures. The activation energy (E_a), activation free energy (ΔG^\ddagger), activation enthalpy (ΔH^\ddagger) and activation entropy (ΔS^\ddagger) were 29.37 kJ mol⁻¹, 103.11 kJ mol⁻¹, 26.35 kJ mol⁻¹ and -241.28 J mol⁻¹ K⁻¹ respectively. Therefore, the title reaction was non-spontaneous. The effect of plasticizer on curing kinetics has also been investigated. It was found that the reaction rate constants and total reaction heat decreased with the increase of DOS contents. The thermodynamic properties of the reaction were studied by varying

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