Application News

SHIMADZU

THERMAL ANALYSIS T103

Glass Transition of Polyvinyl Acetate Type Adhesives

Polyvinyl acetate is widely used as a paint or an adhesive because it is highly soluble in solvents like ketone, ester, and alcohol.
Polyvinyl acetate is solved with solvent in order to lower its glass transition temperature from its usual 38-40° C down to room temperature or lower, for better flowability and workability as an adhesive agent. Glass transition temperature rises as the solvent evaporates.
It is already known from the data of PET fiber-dyestuffs type (1) and nylon-water type (2) that a mixture of high polymer and low polymer materials lowers the melting point of high polymer.
It is also reported for the case of epoxy resin-water type (2) and PET-water type (2) that their glass transition temperature shifts to a lower range in proportion to an increase of volume of added water.
An experiment was made using a polyvinyl acetate adhesive agent for office use in order to find the relationship between the glass transition temperature of polyvinyl acetate and the quantity of organic solvent.
Glass transition temperature was measured with specimens sealed in a cell for prevention of solvent evaporation during measurement with differential scanning calorimeter (DSC). The DSC measurement was followed by a measurement with a thermo-gravimetric analyzer (TGA) using the same cell but with a pin hole in order to determine a reduction ratio of solvent, that is, to determine the volume of solvent.

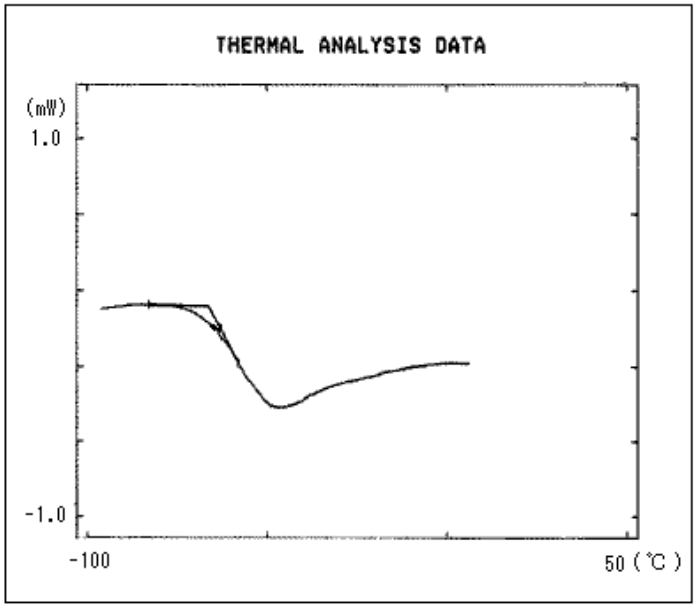

Fig.1 Glass Transition of Adhesive (1)

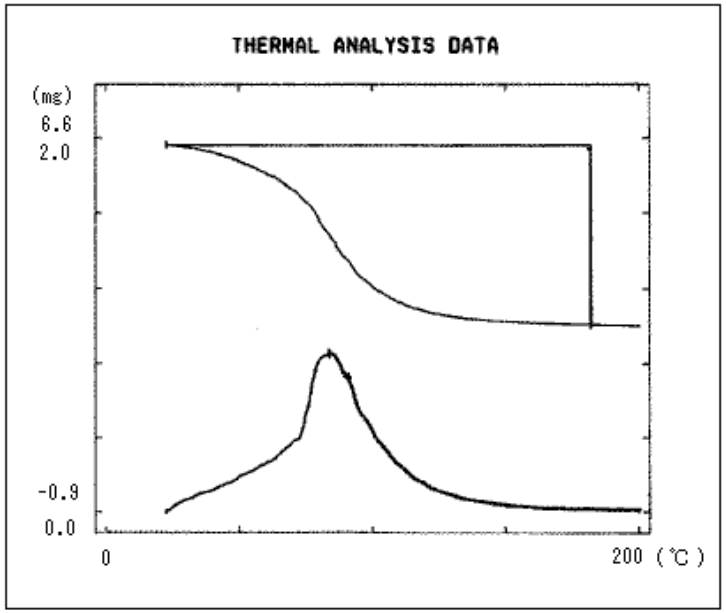

Fig.2 Solvent in Adhesive (1)

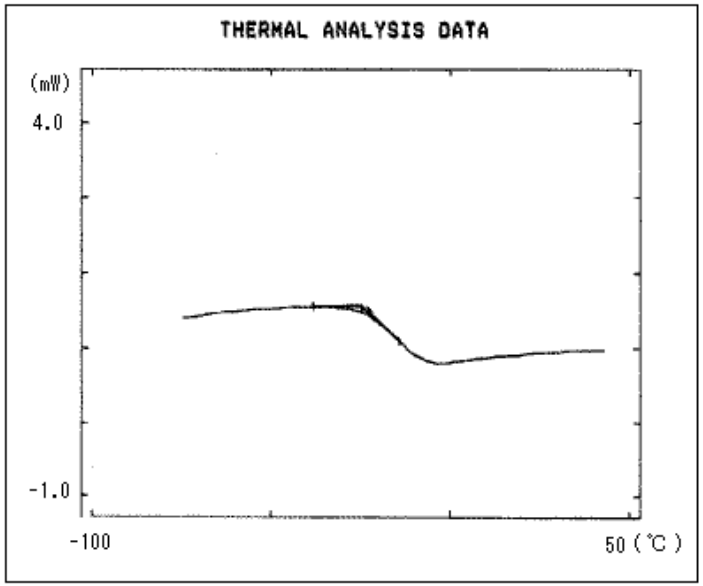

Fig.3 Glass Transition of Adhesive (Solvent 12.20%)

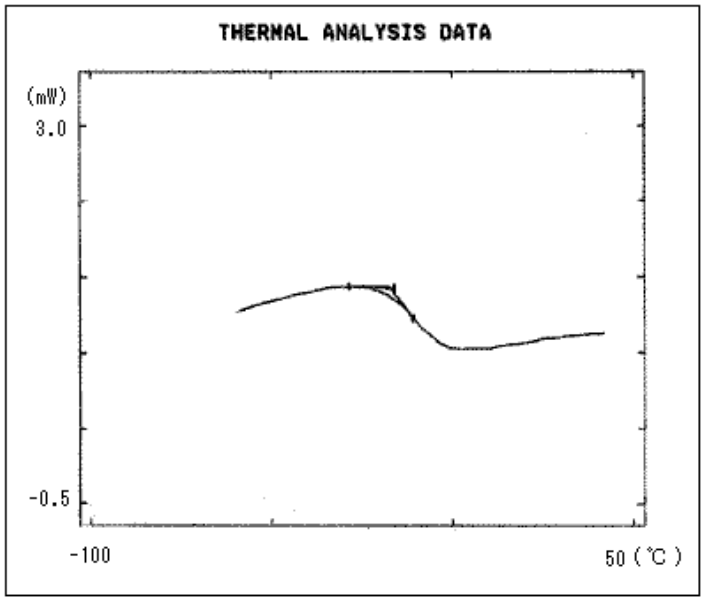

Fig.4 Glass Transition of Adhesive (Solvent 11.04%)

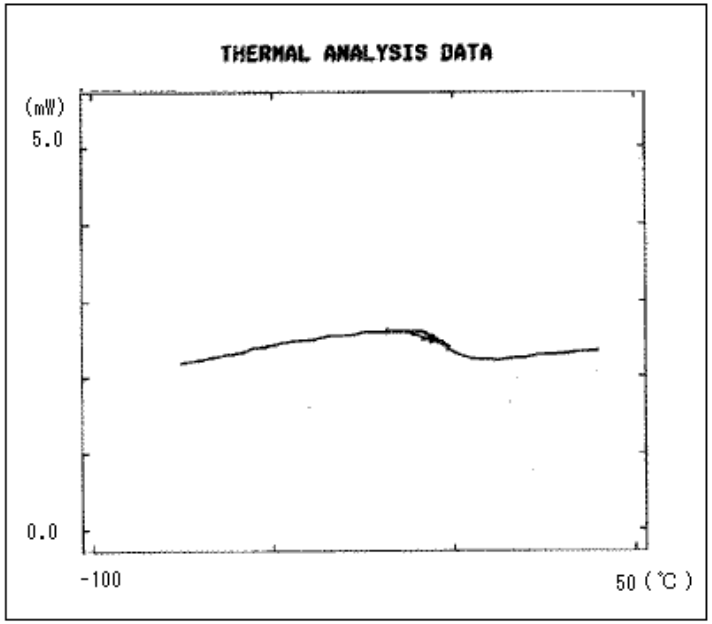

Fig.5 Glass Transition of Adhesive (Solvent 8.57%)

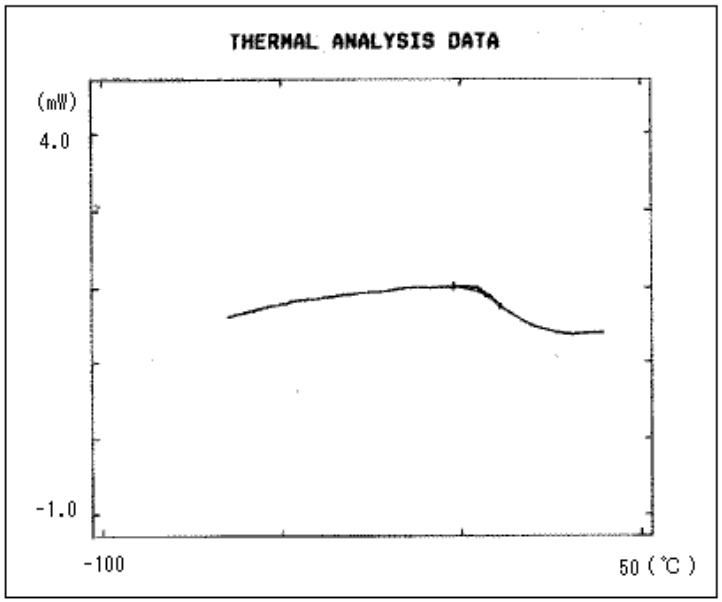

Fig.6 Glass Transition of Adhesive (Solvent 5.04%)

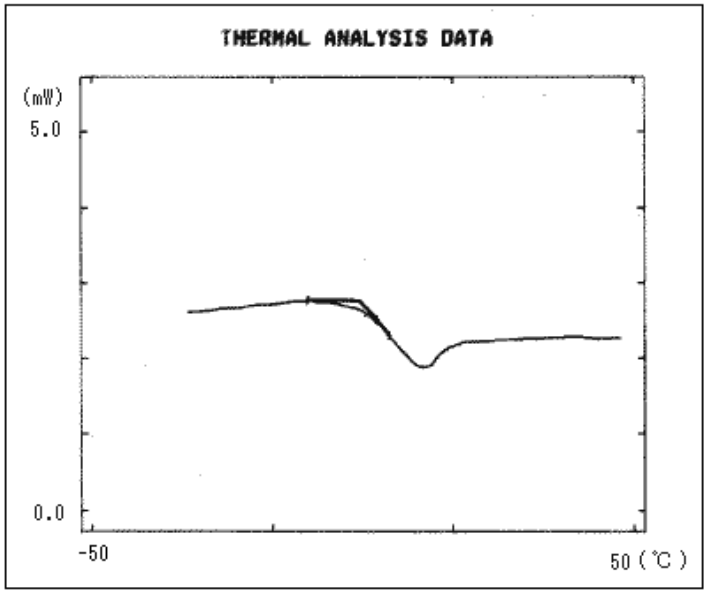

Fig.7 Glass Transition of Adhesive (2)

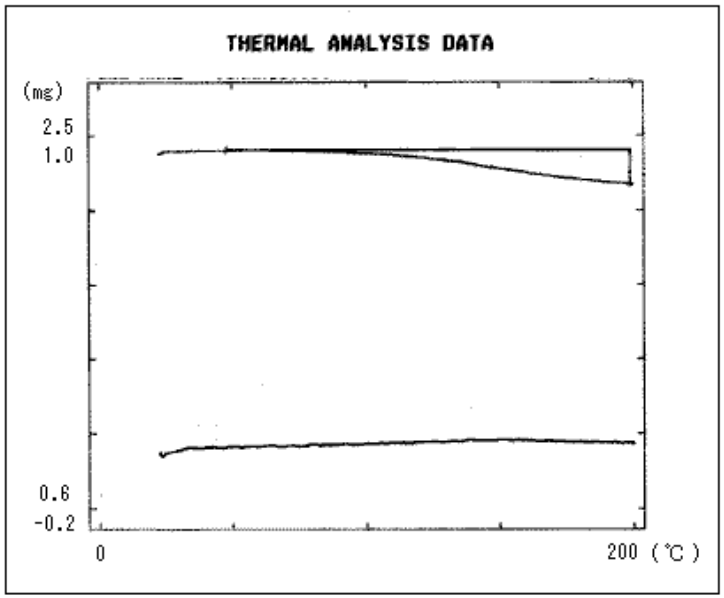

Fig.8 Solvent in Adhesive (2)

Relation between the Temperature and Solvent Concentration

As shown in Fig.1 through Fig.8, the temperature of glass transition of polyvinyl acetate largely depends on the concentration of solvent.
As seen in the plotted curve of Fig.9, the Tg temperature and solvent concentration are in linear proportion with a Tg down ratio of as large as approx. 4˚C for 1 percent increase of solvent concentration.

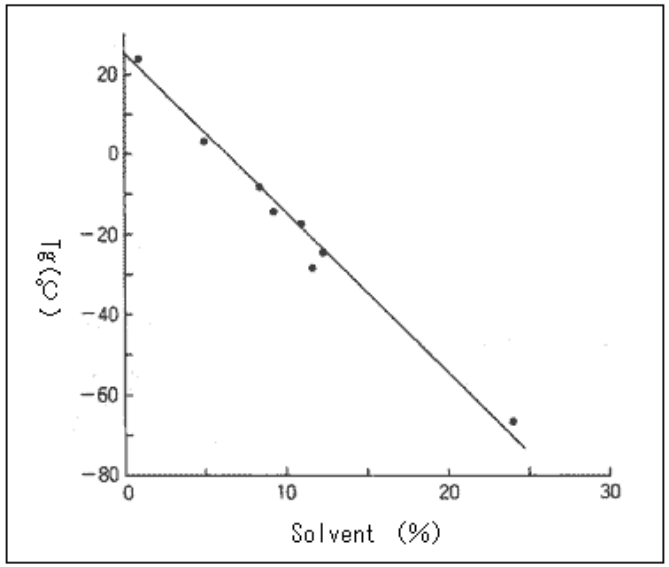

Fig.9 Relation between Glass Transition Temperature of Adhesive and Solvent Concentration

(1) Cited from "Thermal Analysis" edited by Kanbe Hirotarou, p.243, published by Kodansha Scientific (1975).
(2) Cited from textbook for Shimadzu Thermal Analysis Seminar (1988).

* Please be advised that data obtained before the implementation of the current Weights and Measures Law may be presented in terms of gravimetric unit.

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