

CASE STUDY

Many common adhesives are based on thermosetting polymers, which react over time through a process called curing to form the desired rigid final structure. Suppliers of these materials are interested in the rate of cure as well as the rigidity of the final bond.

SOLUTION

Oscillation tests in a rheometer can provide a total curing profile for thermoset adhesives. During these tests, the adhesive is placed in the rheometer immediately after mixing the ingredients and evaluated using a disposable parallel plate geometry oscillating at a frequency of 1 Hz and amplitude of 4×10^{-3} radians. These frequency and amplitude values are usually chosen because 1 Hz is a common reference frequency and low oscillation amplitudes do not risk destroying sample structure. Figure 1 shows the results for two different adhesives.

Adhesive A is a common two part epoxy used to bond metals, wood, concrete and plastics. Adhesive A is advertised as a "ten minute" adhesive meaning that it begins to form a fairly rigid gel structure within ten minutes after mixing at room temperature. Adhesive B is a hybrid between epoxy and acrylic monomers, which is used for automotive and aerospace applications. Its cure reaction also proceeds at room temperature but the reaction is driven by free radical polymerization. As expected, the storage or elastic modulus (G') for Adhesive A is low initially, but undergoes a rapid

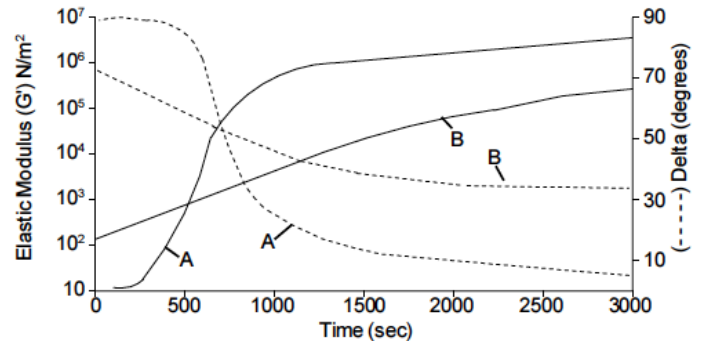


Figure 1. Comparison of Adhesive Cure

increase reflecting cure at about ten minutes to achieve a rigid final material, which has a modulus five decades higher than the starting material. Furthermore, cure is essentially complete after about 25 minutes. Adhesive B, on the other hand, cures more gradually, and is in fact still curing after 50 minutes. Longer test times would be required to determine the final modulus for Adhesive B, as well as whether it ultimately is more rigid when fully cured than Adhesive A.

ACKNOWLEDGEMENT

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For more information or to place an order, go to <http://www.tainstruments.com/> to locate your local sales office information.