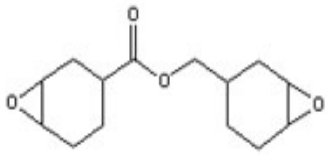
Quantitation of Epoxy to Hardener Ratios in a Cycloaliphatic Epoxy

Application Note
Epoxies

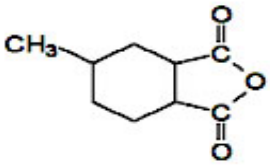
Author:

T. Wampler

Although many common epoxy resins are formulated using Bisphenol A, aliphatic, especially cyclyhexyl compounds, are also used. The epoxies shown here were formulated with varying amounts of 3,4-Epoxycyclohexylmethyl 3,4- epoxy cyclohexane carboxylate, shown below:



and hardened using methylhexahydrophthalic anhydride (MHHPA), which has the structure:



The samples used epoxy to hardener ratios of 0.50, 0.66 and 1.00. When pyrolyzed, each sample produced a pyrogram like the one shown in Figure 1, with most of the components eluting as three peaks at about 14 minutes. Figure 2 shows an expanded view of the epoxies, with epoxy to hardener ratios of 1:2 and 1:1.

Ascribing the first peak to the epoxy resin and the third peak to the hardener, peak area ratios were plotted agains the relative amounts of the constituents. This produced a linear graph for the range of constituent ratios, shown in Figure 3.

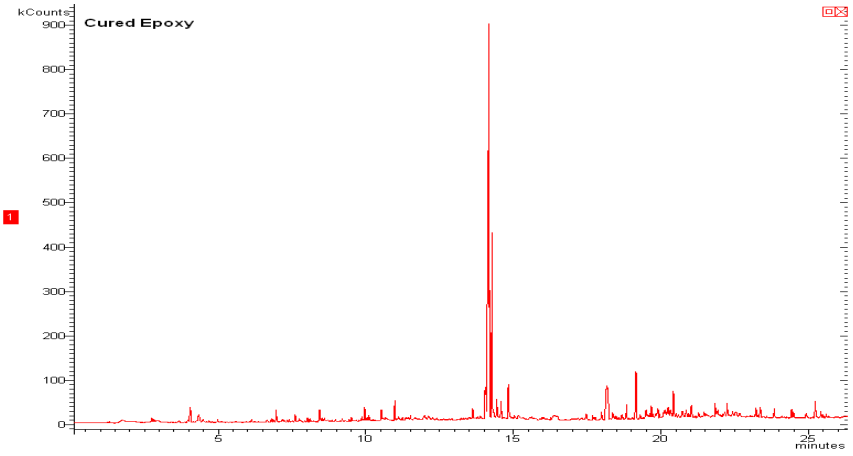


Figure 1. Pyrogram of epoxy at 750°C.

Instrument Conditions

Pyroprobe

Pyrolysis:	700°C 15 seconds
Interface:	325°C for 4 minutes
Valve Oven:	325°C
Transfer Line:	325°C

GC/MS

Column:	5% phenyl (30m x 0.25mm x 0.25μm)
Carrier:	Helium, 75:1 split
Injector:	300°C
Oven:	40°C for 2 minutes
	10°C/min to 325°C
Mass Range:	35-600 amu

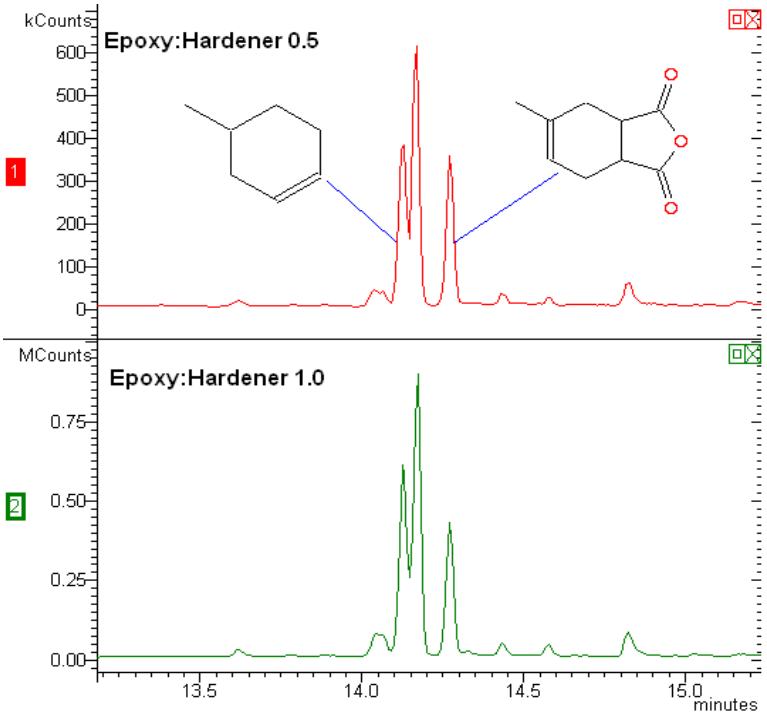


Figure 2. Expanded view of pyrogram.

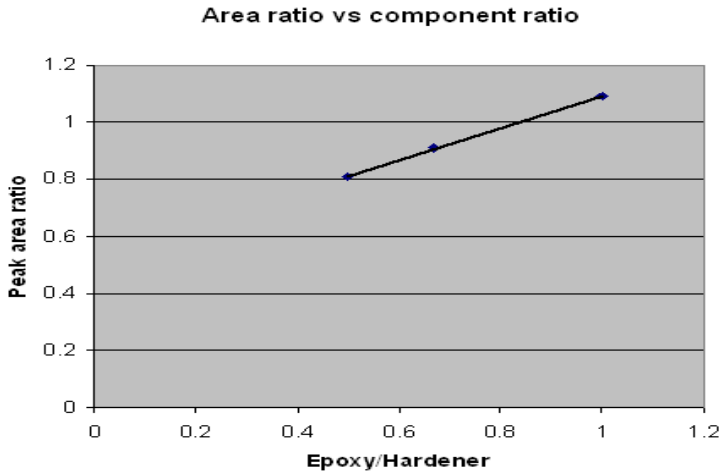


Figure 3. Graph of peak area ratio vs component ratio.

FOR MORE INFORMATION
CONCERNING THIS APPLICATION, WE RECOMMEND THE
FOLLOWING READING:

H. Nakagawa and S. Tsuge,
Studies on Thermal Degradation of Epoxy Resins by High-resolution Pyrolysis-Gas Chromatography,
J. Anal. Appl. Pyrolysis 7 (1987) 113.