UC 0001 #2

STATUS REPORT

MECHANICAL PROPERTIES OF ESTANE-CHLOROBENZENE-ASBESTOS SYSTEMS

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SUMMARY Mechanical properties have been determined for blends of Estane polyurethane, chlorobenzene, and asbestos. The tensile properties of these systems are equivalent to or better than Estane at asbestos contents of up to 30%.

About 30-35% asbestos can be added to the Estane-chlorobenzene system and still obtain transparent molded plaques. Without the chlorobenzene, even 10% asbestos is readily visible in Estane. Since the additives are considerably cheaper than the elastomer, these systems or similar ones may be of commercial importance.

INTRODUCTION In a recent report (1) we commented on the fact that the addition of chlorobenzene to Estane 5701-F1 (a B. F. Goodrich Chemical Company polyurethane) had a marked effect on the tensile properties of the polymer. This improvement of tensile properties prompted an investigation of the effect of asbestos filler on the tensile properties of the Estane-chlorobenzene system.

EXPERIMENTAL Various amounts of chyrsotile asbestos (high purity, Coalinga) were milled into Estane containing 12-15% chlorobenzene at 120-150°C. for 5 minutes. (All percentages listed in this report are based on the Estane). Plaques of the milled material were molded at 150°C. and 1000-2000 psi (10 seconds). Room temperature tensile properties were obtained with an Instrom tester at a strain rate of 20 percent per minute. The real component of the complex shear modulus, G', and the mechanical loss were obtained as a function of temperature with the recording torsion pendulum.

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DISCUSSION The first point of interest was that the molded plaques were clear when up to 33% asbestos was added, i.e., no small particles of asbestos were visible. However, in the absence of chlorobenzene even 10% asbestos (the lowest asbestos composition investigated) was clearly visible in the molded plaques. It seemed that milling at 150°C. produced clearer plaques than those obtained by milling at about 120°C. Orientation of the clear plaques resulted in an opaque, white material.

In Figure 1 the mechanical loss spectra of Estane and of certain chlorobenzene-asbestos-Estane systems are shown. As might be expected, chlorobenzene causes a decrease in the glass transition temperature, Tg, of Estane. Addition of 23% asbestos resulted in an increase in Tg. If the asbestos were acting as an inert filler one would not expect a change in Tg, although the magnitude of the mechanical loss should decrease at the transition. Therefore, the increase we see in Tg probably reflects an interaction of the asbestos with the Estane-chlorobenzene system. The clarity of the molded plaques is another indication that an interaction exists. Figure 2 shows the real portion of the complex shear modulus as a function of temperature. It is interesting to note that even though the glass transition occurs at a lower temperature with the Estane-chlorobenzene system, above 0°C. the shear modulus is significantly higher (in keeping with the tensile data). Also, this system will be more flexible from -20 to 0°C. than Estane. Addition of asbestos caused the shear modulus to be markedly higher over the temperature range investigated.

The tensile properties of the systems studied are shown in Figure 3, 4, 5 and 6 as a function of the percent asbestos added. As a reference point, the tensile property of Estane containing no additives is shown on each plot. Young's modulus, Figure 3, increases as the amount of asbestos added is increased. The percent elongation, Figure 4, decreases as the asbestos content is increased, however, even with 30-40% asbestos the Estane-chlorobenzene-asbestos system has the same elongation as Estane without these additives. Thus, for an end use that requires a higher initial modulus along with the inherent elongation of the polyurethane, these blends may show some promise. In addition, it should be noted that two low cost materials can be added in fairly high amounts and still maintain the same properties in a rather expensive polymer.

The rupture energy, Figure 5, and the ultimate strength, Figure 6, of the asbestos systems decrease as the

asbestos content is increased. However, here again up to about 30% asbestos can be added to the Estane-chlorobenzene system and still achieve property values equal to that of Estane.

Joseph V. Koleske

References

1. Faucher, J. A. and J. V. Koleske, Informal Report, Tensile Properties of Estane with Various Additives, Project No. 399A50, 15 Sept., 1965.

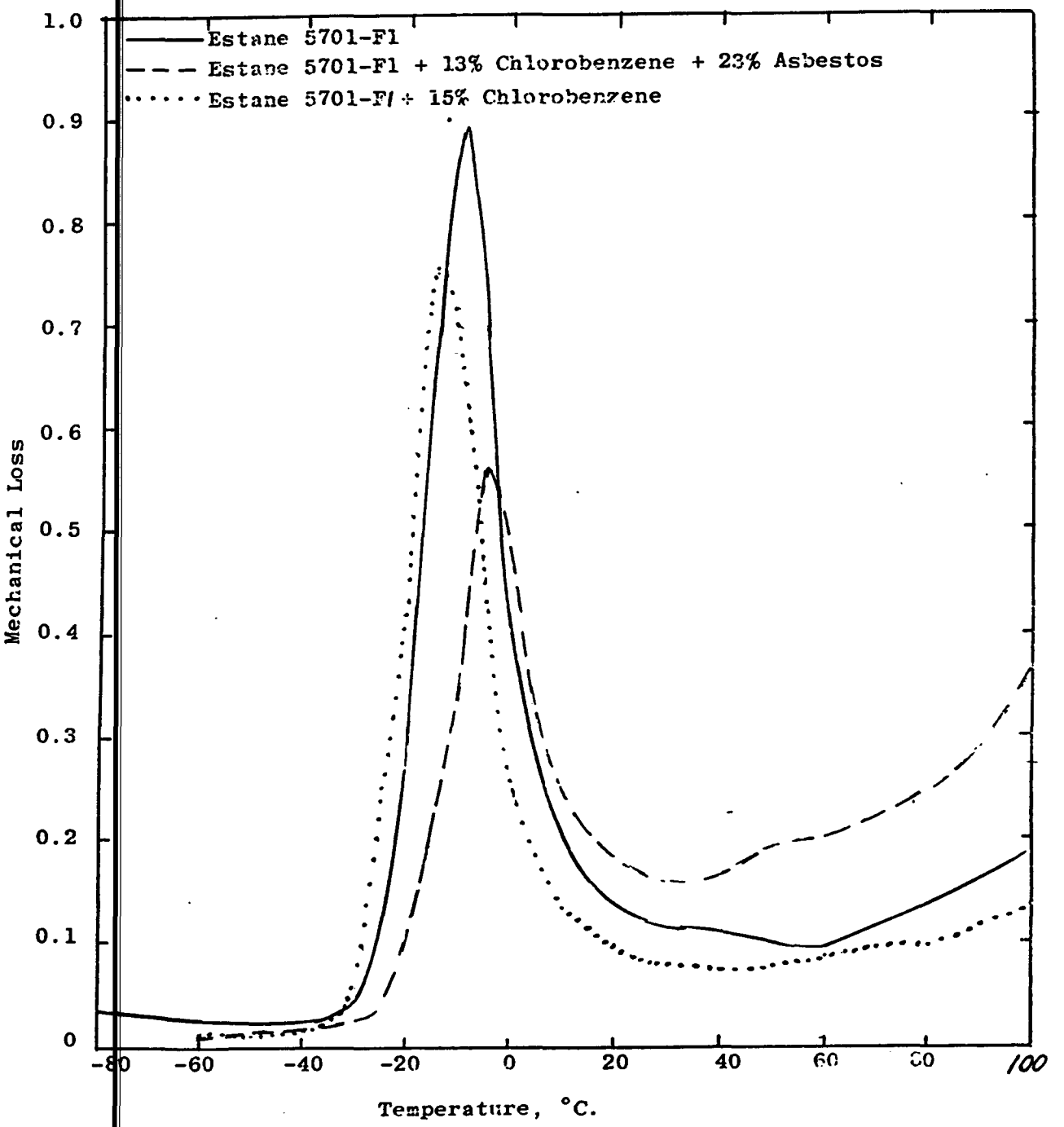
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Attachments: 6 Figures

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Figure 1.

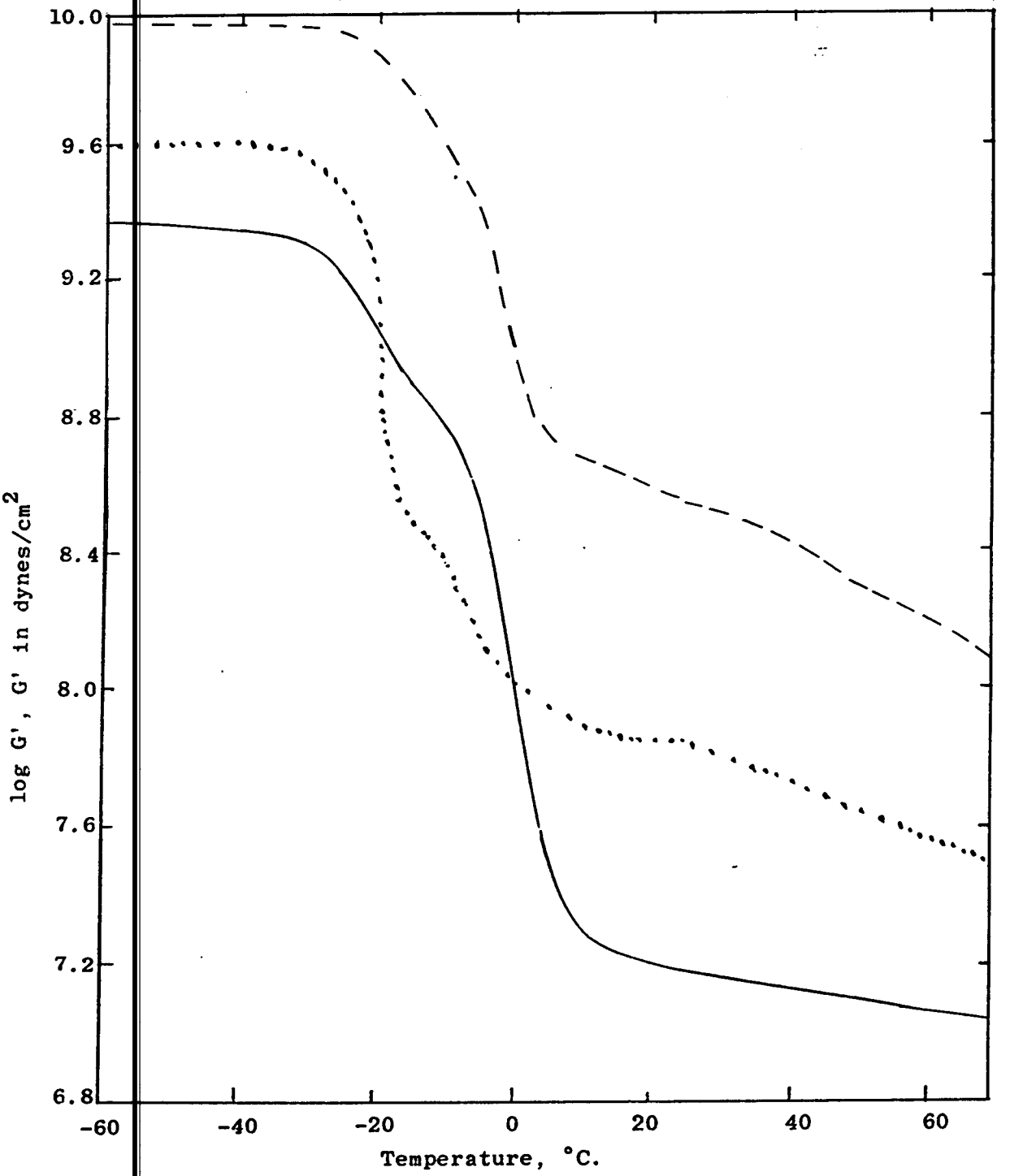
Mechanical loss of Estane and Estane plus additives



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Figure 2

Real portion of the complex shear modulus, G′, for Estane ————, Estane + 15% Chlorobenzene ·····, and Estane + 13% Chlorobenzene + 23% Asbestos ----



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Figure 3. Young's Modulus of Estane-Chlorobenzene-Asbestos Systems. Samples contained 12-15% chlorobenzene and indicated amounts of asbestos based on only Estane. Open circles are average values and the vertical lines indicate the maximum and minimum test values.

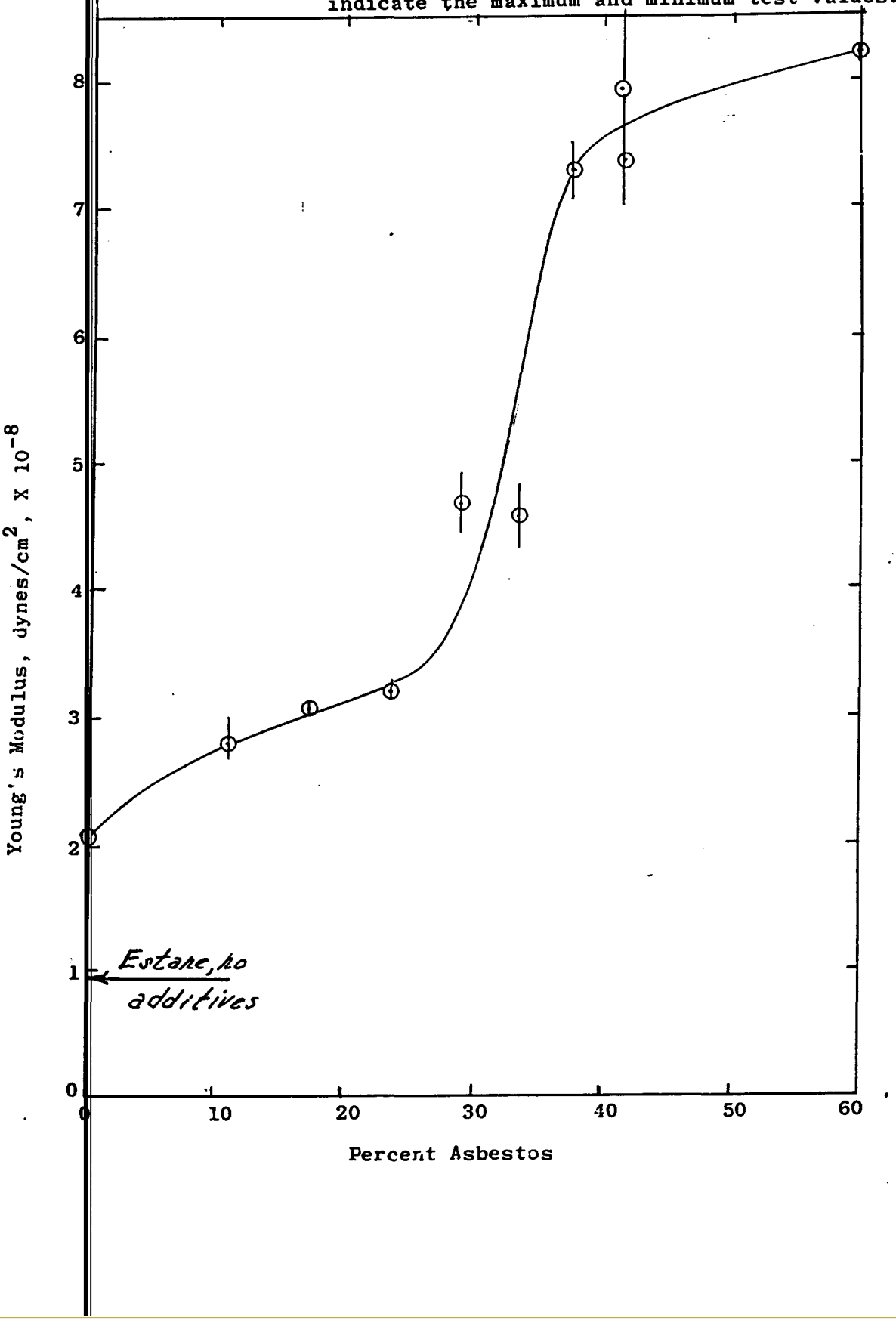
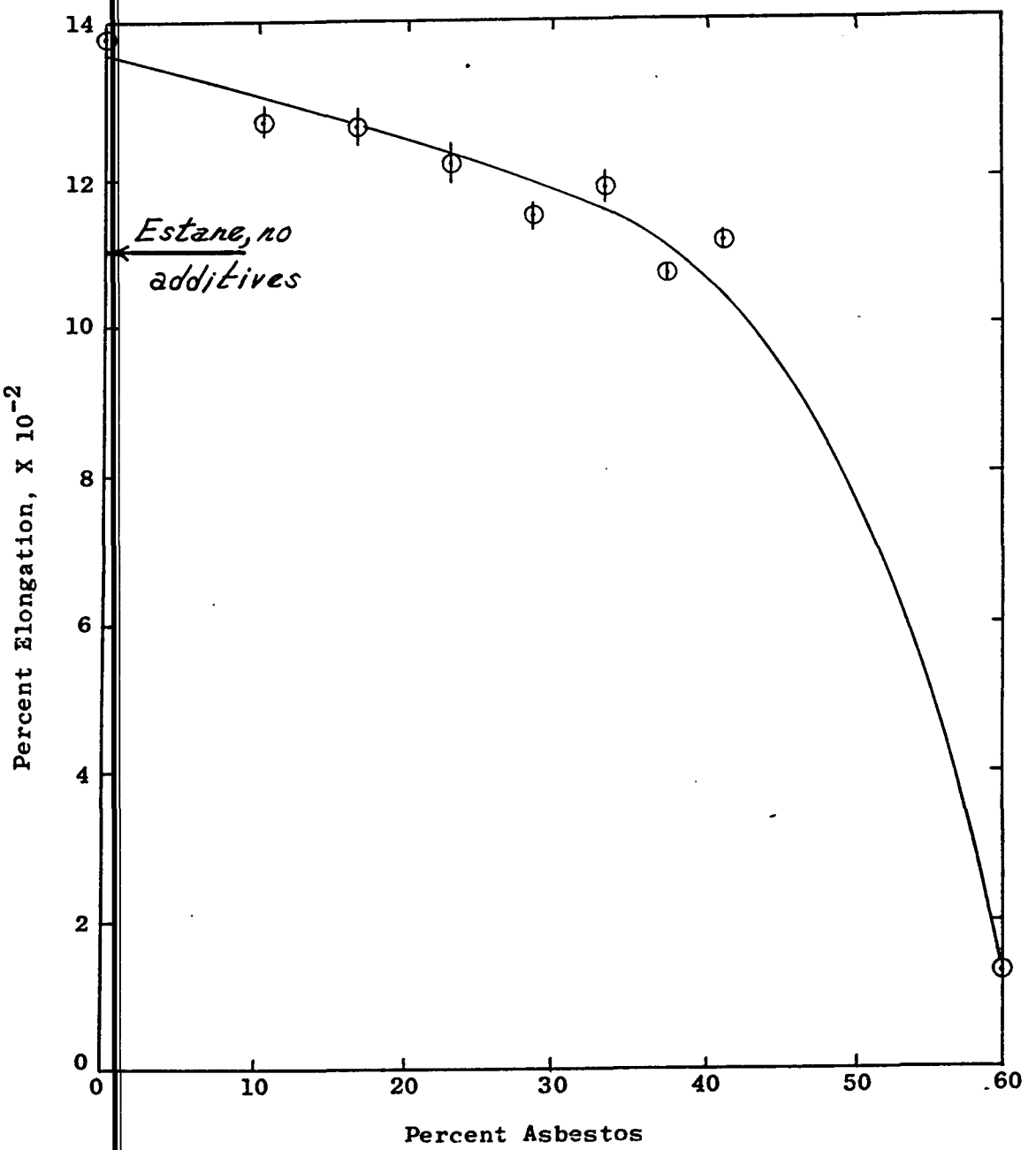
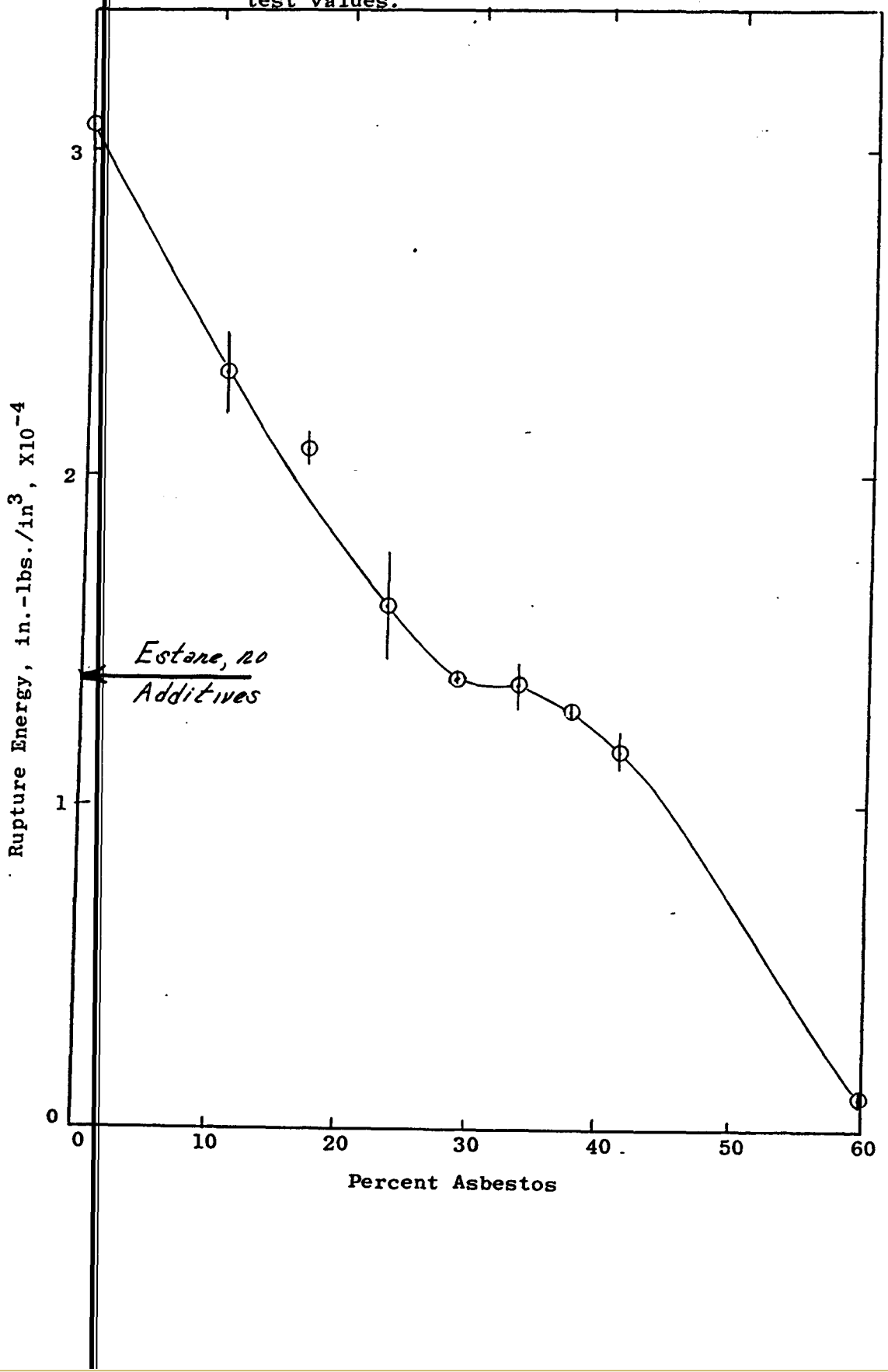


Figure 4. Percent Elongation of Estane-Chlorobenzene-Asbestos Systems. Samples contained 12-15% chlorobenzene and indicated amounts of asbestos based on only Estane. Open circles are average values and the vertical lines indicate the maximum and minimum test values.



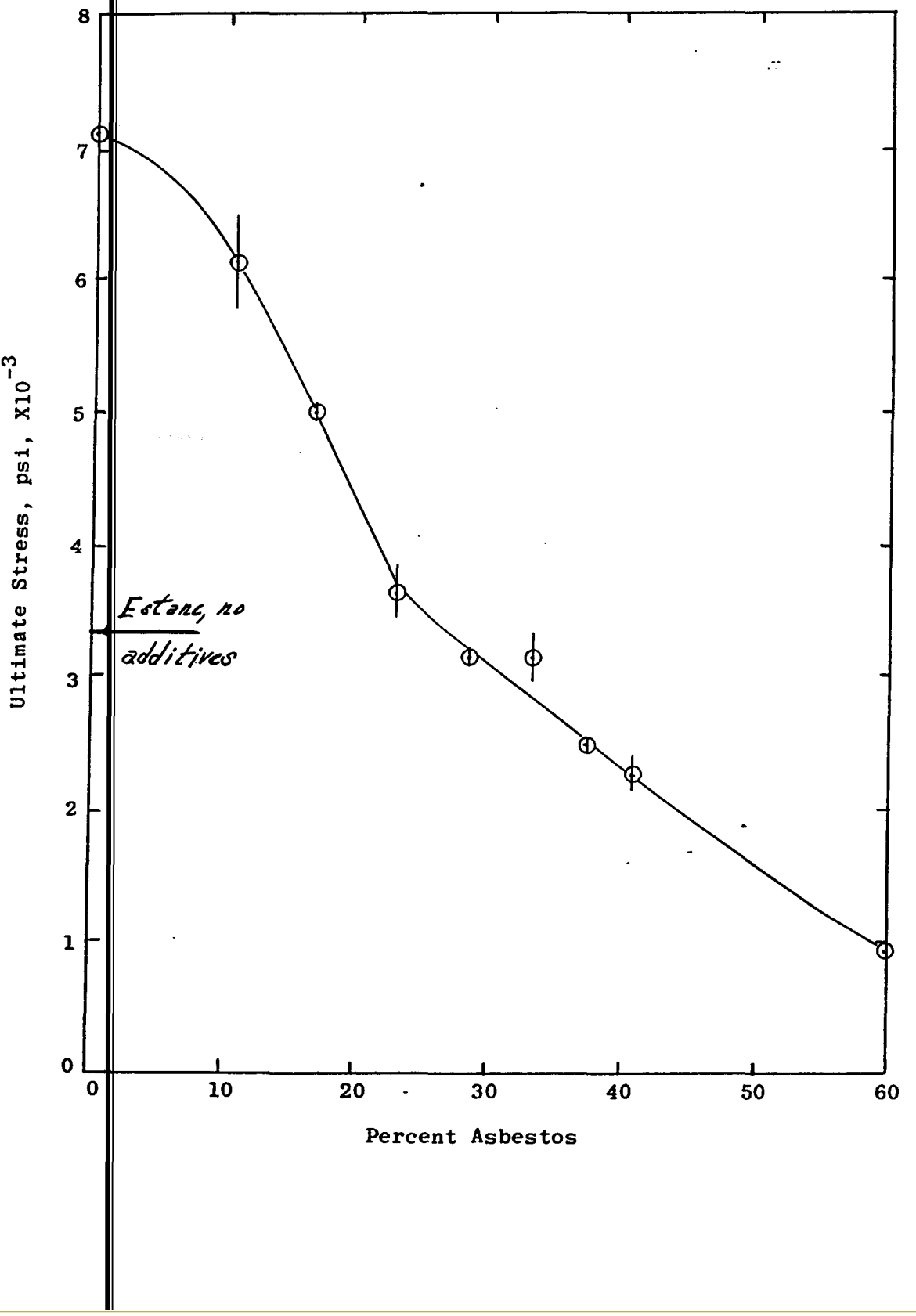
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Figure 5. Rupture Energy of Estane-Chlorobenzene-Asbestos Systems. Samples contained 12-15% chlorobenzene and indicated amounts of asbestos based on only Estane. Open circles are average values and the vertical lines indicate the maximum and minimum test values.



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Figure 6. Ultimate Stress of Estane-Chlorobenzene-Asbestos Systems. Samples contained 12-15% chlorobenzene and indicated amounts of asbestos based on only Estane. Open circles are average values and the vertical lines indicate the maximum and minimum test values.



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