Hg Amalgams are Homogeneous Compounds Having Liquid Metal Properties

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Hg AMALGAMS ARE HOMOGENEOUS COMPOUNDS HAVING LIQUID METAL PROPERTIES

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By means of a toroidal oscillating viscometer, logarithmic decrements of dampings have been measured in presence of HgTl amalgam at 28.1 atomic percent thallium, at different temperatures, ranging from 12,5°C to 17°C, with fluctuations every 0,25°C. In addition, the solidification process of HgIn amalgam has been investigated.

Keywords: Phase diagram; viscometer damping

INTRODUCTION

Extensive research has been dedicated to Hg amalgams (HgIn, HgK, HgTl) [1,2,3,4]. Particular attention has been focused, in recent years, on HgTl amalgams at various atomic percentages. In the present study we focused on the logarithmic decrements of a viscometer dampings in the presence of HgTl amalgam at 28,1% at. Tl at different temperatures. In addition, the solidification process of HgIn amalgam has been investigated.

EXPERIMENTAL APPARATUS

The toroidal oscillating viscometer used in the present investigation was the same as previously employed [1,2,3,4].

EXPERIMENTAL RESULTS

The viscometer dampings (δ_M) in presence of HgTl amalgam at 28,1% at. Tl have been measured at different temperatures, ranging from 12,5°C to 17°C, with fluctuations every 0,25°C. As already observed for HgTl amalgam at 28,1% at. Tl [4], the 28,1% at. Tl amalgam showed anomalous recordings of the logarithmic decrements (Figs. 1' and 2').
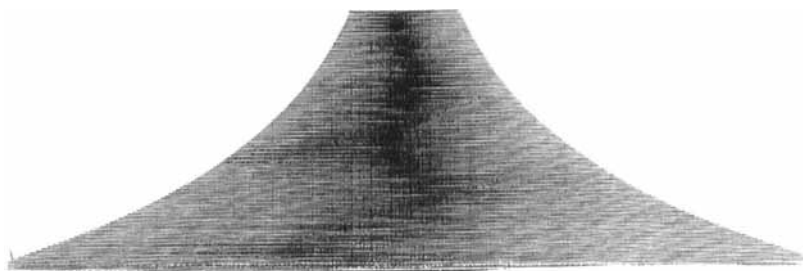
FIGURE 1' Oscillation decay records of a toroidal viscometer filled with HgTl amalgam at 28,1% at. Tl at the temperature of 16,5°C.
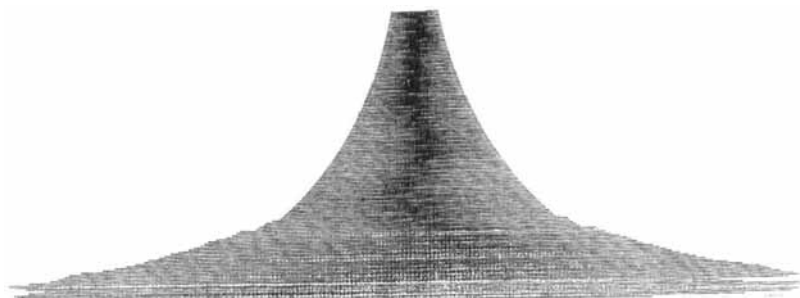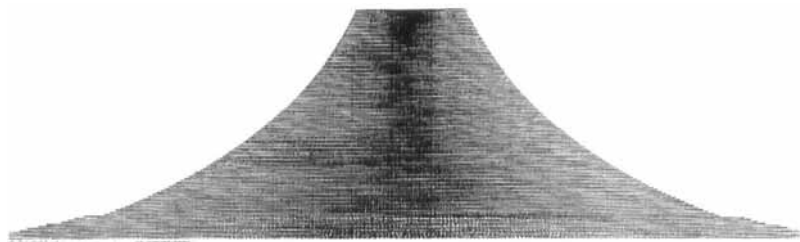

FIGURE 2' Oscillation decay records of a toroidal viscometer filled with HgTl amalgam at 28,1% at. Tl at the temperatures of 16,5°C and 15,375°C.

Values of logarithmic decrement of normal (δ_M) and anomalous (δ_M^*) recordings are plotted in Figures 1 and 2, respectively. Differences between δ_M and δ_M^* have then been calculated (δ_M^{**}) and are plotted in Figure 3. In Figures 4 and 5 comparisons between δ_M and δ_M^* (Fig. 4) or δ_M and δ_M^{**} (Fig. 5) are presented. As clearly showed, values of δ_M and δ_M^* are perfectly coincident, being δ_M^{**} negligible. (Fig. 6)

In previous work, the melting process of HgIn amalgam was studied [1]. Following extensive research on the HgTl amalgam, experiments were performed to get insights in the solidification process of the HgIn amalgam. In this view, the logarithmic decrements of a viscometer dampings in the presence of HgIn amalgam at two different percentage, 15% at. In and 30% at. In, were measured at different temperatures, from $-14°C$ to $30°C$ for 15% at. In and from $-14,75°C$ to $38°C$ for 30% at. In. Values of δ_M recordered for the two experimental conditions are plotted in Figures 6(a) (15% at. In) and (b) (30% at. In).
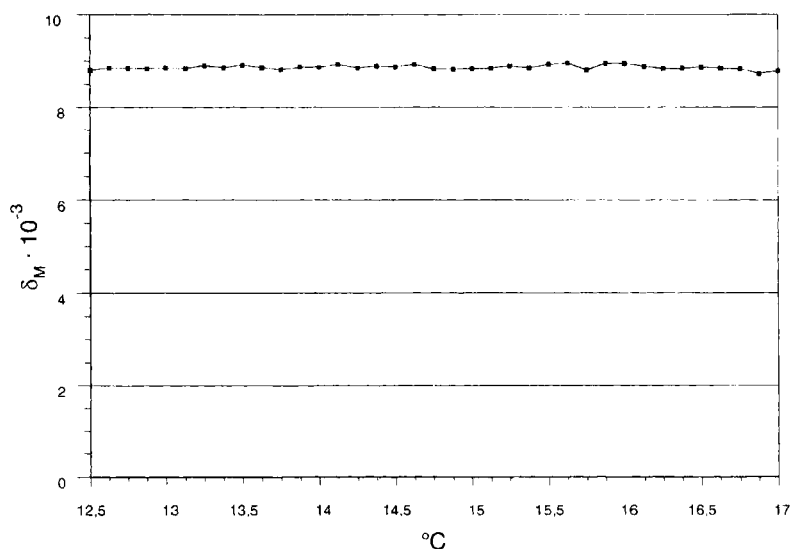

FIGURE 1 Mean values of logarithmic decrements of normal dampings (δ_M) of HgTl 28,1% at. Tl *versus* temperature (from 12,5°C to 17°C with fluctuations every 0,25°C).
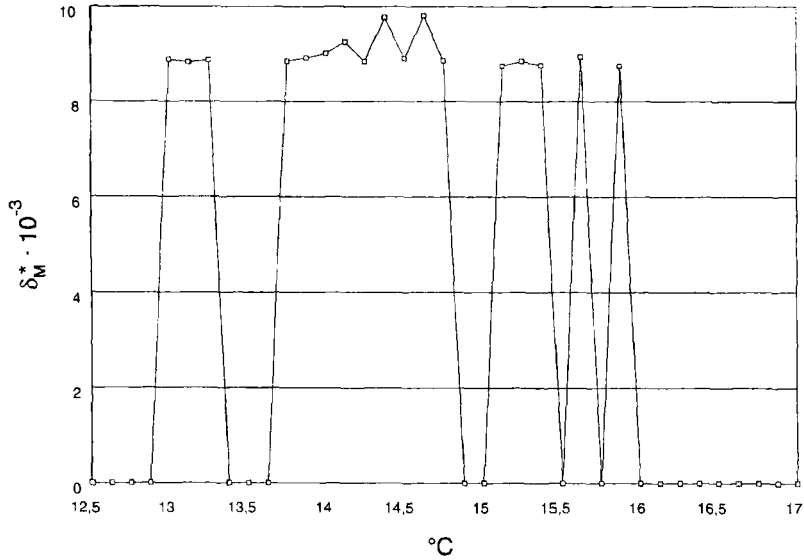
FIGURE 2   Mean values of logarithmic decrements of anomalous dampings (δ_M^*) of HgTl 28,1% at. Tl *versus* temperature (from 12,5°C to 17°C with fluctuations every 0,25°C).
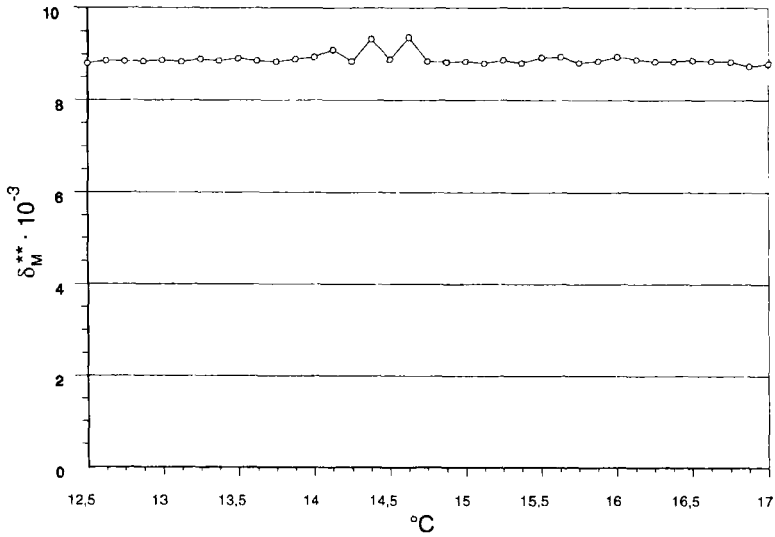

FIGURE 3   Differences (δ_M^{**}) between mean values of logarithmic decrements of normal (δ_M) and anomalous (δ_M^*) dampings.
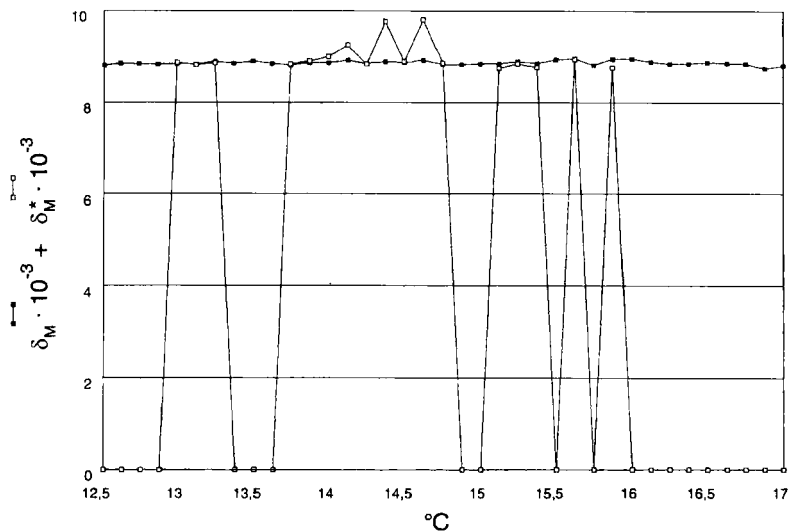
FIGURE 4 Comparison between mean values of logarithmic decrements of normal (δ_M) and anomalous (δ_M^*) dampings.
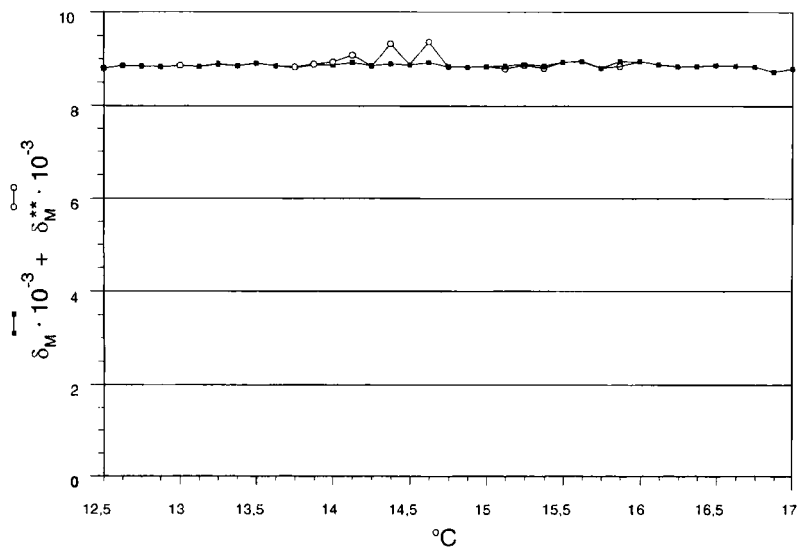

FIGURE 5 Comparison between mean values of logarithmic decrements of normal dampings (δ_M) and differences (δ_M^{**}) between mean values of logarithmic decrements of normal (δ_M) and anomalous dampings (δ_M^*).
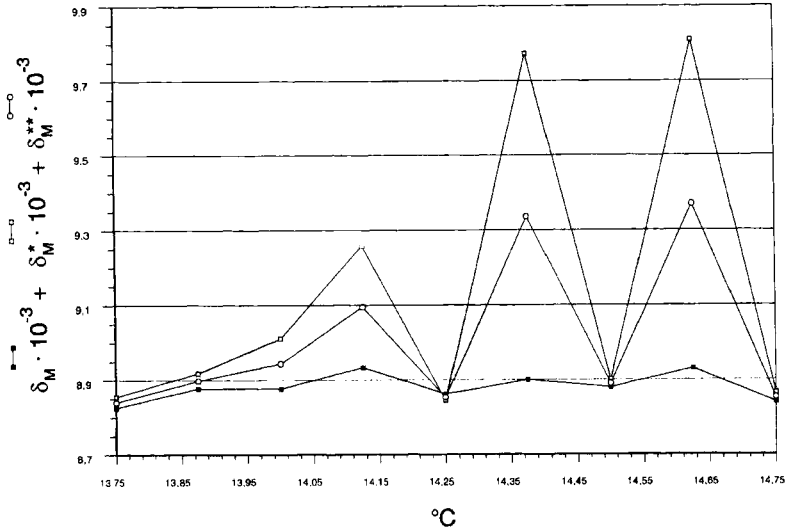
FIGURE 6   Resumptive plots of δ_M, δ_M^* and δ_M^{**}.
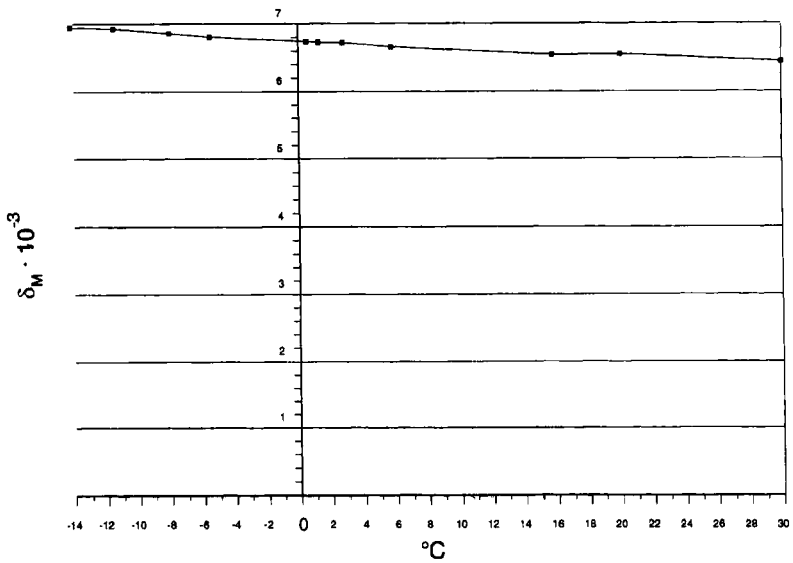
FIGURE 6a   Logarithmic decrements of viscometer dampings in the presence of HgIn amalgam at 15% at. In at different temperatures (from $-14°C$ to $30°C$).
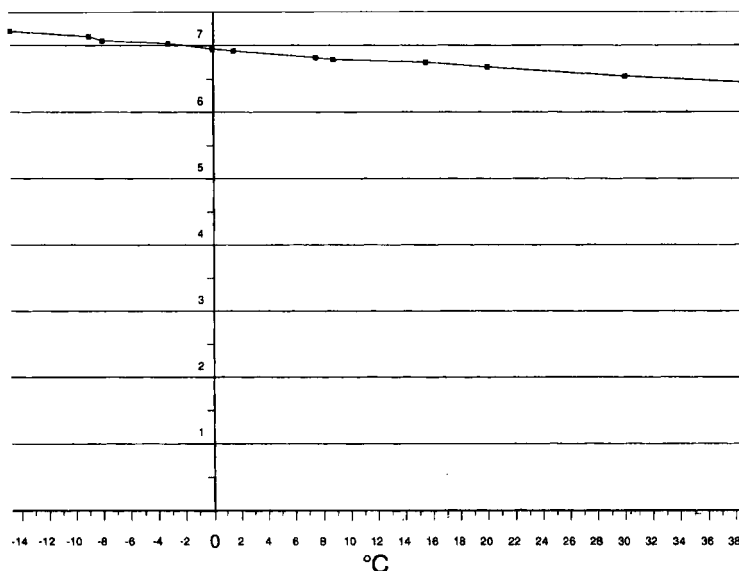
FIGURE 6b   Logarithmic decrements of viscometer dampings in the presence of HgIn amalgam at 30% at. In at different temperatures (from −14,75°C to 38°C).

DISCUSSION OF EXPERIMENTAL RESULTS

The solidification process of HgTl amalgam at 28,1% at. Tl shows the same characteristics observed for the 28,2% at. Tl [4]. Anomalous recording do not correspond to a different amalgam behavior, since δ_M^{**} is negligible.

When considering the HgIn amalgam, present results let us conclude that its solidification process occurs as for HgTl amalgams.

The theoretical aspects considered for the HgIn may applied to HgTl amalgams as well. Since HgK amalgam showed a similar behavior with regard to its viscosity [2], it is conceivable that Hg amalgams are homogeneous compounds having liquid metal properties.

SUMMARY

The logarithmic decrements of the dampings of an oscillating viscometer in presence of the HgTl amalgam at 28,1 % at. Tl has

been measured at different temperatures, ranging from 12,5°C to 17°C, with fluctuations every 0,25°C. The amalgam showed anomalous recordings of the logarithmic decrements. Calculation of viscometer dampings of normal and anomalous recordings did not yield detection of significant differences. In addition, the solidification process of HgIn amalgam has been investigated.

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