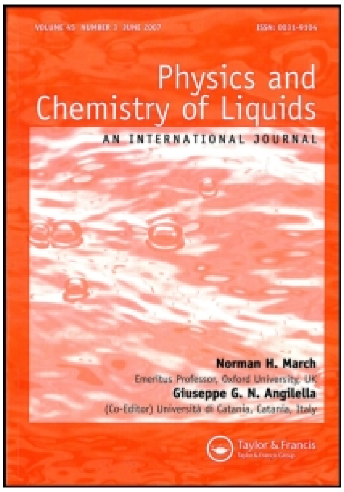

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STUDY ON THE SOLIDIFICATION PROCESS OF HgTl AMALGAM AT 28.2 AT.% Tl

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By means of a toroidal oscillating viscometer, logarithmic decrements of dampings have been measured in presence or absence of HgTl amalgam at 28.2 atomic percent thallium, at different temperatures, ranging from −16.5 C to +6.5°C, with fluctuations every 0.25°C.

KEY WORDS: Phase diagram, viscometer damping.

INTRODUCTION

In previous papers[1,2,3] the HgTl amalgam was investigated at various atomic percentage. The HgTl amalgam at 28.2 at % Tl raised some interest about its solidification process. In the present study we focused on the logarithmic decrements of a viscometer dampings in the presence or absence of this amalgam, at different temperatures, from −16.5°C to +6.5°C.

EXPERIMENTAL APPARATUS

The toroidal oscillating viscometer used in the present investigation is the same as employed in Refs. 1,2,3.

EXPERIMENTAL RESULTS

The viscometer dampings in presence or absence (δ and δ_0 respectively) of the HgTl amalgam at 28.2 at % Tl have been measured at different temperatures, ranging from −16.5°C to +6.5°C, and the fluctuations are every 0.25°C. For the dampings obtained in the temperature range from +1.5°C to +6.5°C the viscosity η has been calculated using formula (1), as reported in Ref. 2

$$\frac{I\sqrt{2}}{4\pi^3 a^2 R^3 \rho}\left[\left(1+\frac{T^2}{T_0^2}\right)\delta - 2\frac{T}{T_0}\delta_0\right] = g_1(q) - \delta g_2(q) + \frac{a^2}{R^2} g_3(q) \tag{1}$$

The experimental results are plotted in Figures 1,2,3.

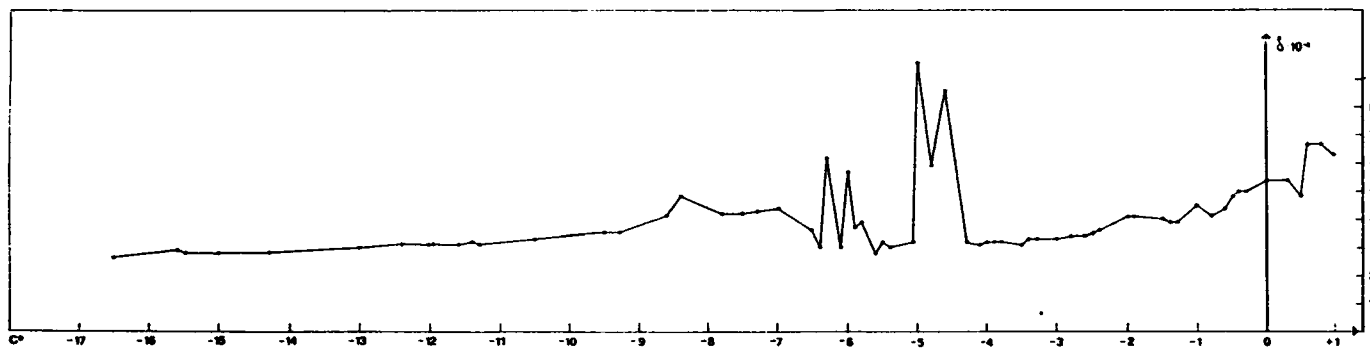

Figure 1 Logarithmic decrements of dampings of the viscometer containing the HgTl amalgam at 28.2 at.% Tl versus temperature (from +1°C to −16.5°C).

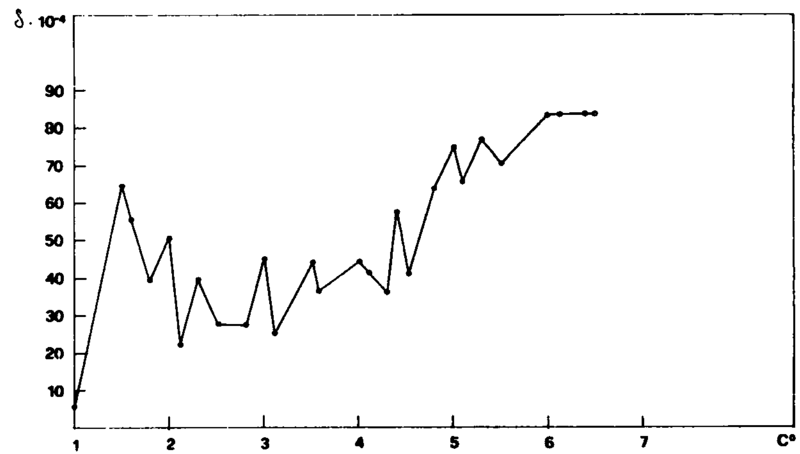

Figure 2 Logarithmic decrements of dampings of the viscometer containing the HgTl amalgam at 28.2 at.% Tl versus temperature (from +1°C to +7°C).

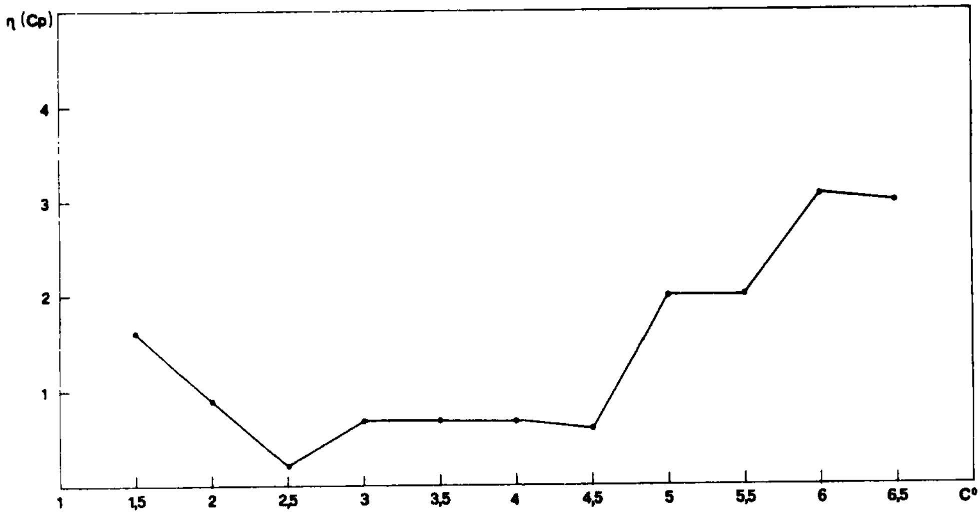

Figure 3 HgTl amalgam at 28.2 at.% Tl viscosity (cp) versus temperature (°C).

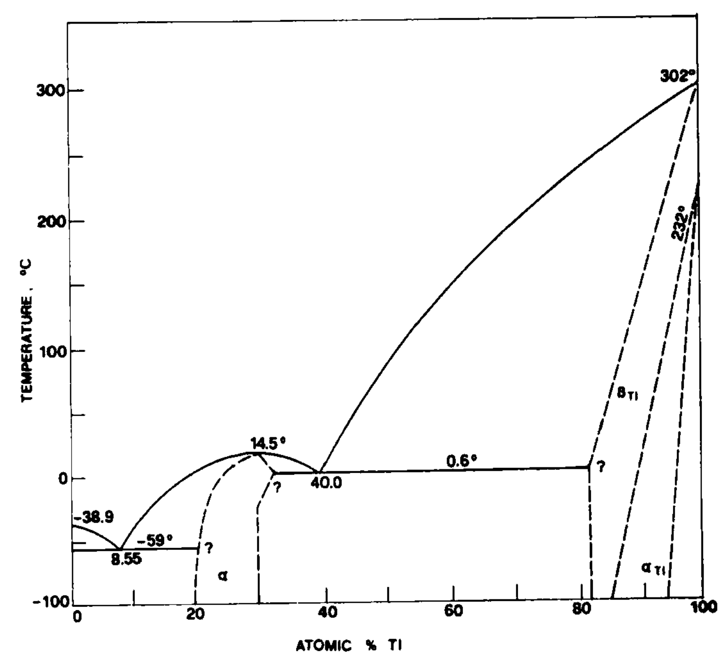

Figure 4 Phase diagram.

In Figure 4 is represented the phase diagram.

DISCUSSION OF THE EXPERIMENTAL RESULTS

The solidification process of HgTl amalgam at 28.2 at.% Tl occurs gradually, as the temperature-dependent δ variations show in Figure 1. At the temperature of $-5.6°C$ we obtained $\delta = 2.849043 \cdot 10^{-4}$ and $\delta_0 = 2.44248 \cdot 10^{-4}$. We may conclude that at this temperature the amalgam is completely solid. These results are according to theoretical values obtained from Ref. 4.

In fact, from Ref. 4

$$\delta = \frac{\delta_0 I_0 T}{I T_0}$$
$$T = \frac{\pi T_0 I}{\sqrt{I_0[I(\pi^2 + \delta_0^2 T_0)] - \delta_0 I_0}} \tag{2}$$

where I_0 = the total moment of inertia of the system without the amalgam; $I = I_0 + 2\pi^2 R^3 a^2[1 + \frac{3}{4}(a^2/R^2)]$; a, R and ρ have the same values as in Ref. 2; T and T_0 are the period of the system with and without the amalgam, respectively.

Introducing experimental values obtained at the temperature of $-5.6°C$ in formula (2), it derives:

$$\delta = 2.41597 \cdot 10^{-4}$$

The difference between experimental and theoretical values of δ at the above temperature, is

$$\Delta_\delta = 0.4 \cdot 10^{-4}$$

For the temperature of $-15°C$, we obtained

$$\Delta_\delta = 3.5 \cdot 10^{-5}$$

It follows that for temperature values lower than $-15°C$, $\delta = 2.796423 \cdot 10^{-4}$ and the amalgam remain completely solid.

The results plotted in Figure 3 let us affirm that the amalgam is totally liquid at a temperature level greater than that reported in the literature (Figure 4).

SUMMARY

The logarithmic decrements of the dampings of an oscillating viscometer in presence or absence (δ and δ_0 respectively) of the HgTl amalgam at 28.2 at.% Tl have been measured at different temperatures, ranging from $-16.5°C$ to $+6.5°C$.

It has been found that the HgTl amalgam at 28.2 at.% Tl is completely solid at the temperature of $-5.6°C$, with $\delta = 2.849043 \cdot 10^{-4}$ and $\delta_0 = 2.44248 \cdot 10^{-4}$.

Furthermore, for temperature values lower than $-15°C$, $\delta = 2.796423 \cdot 10^{-4}$ and the amalgam remains definitely solid.

Acknowledgement

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