CONTRIBUTION TO THE LOCATION OF γ-PHASE IN THE Sb-Zn SYSTEM OF ALLOYS[*]

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Abstract: The results of dilatometric investigations of Sb-Zn alloys in the composition range 36-42 wt.% Zn are presented. A new phase transformation in the alloys between 36 and 40 wt.% Zn, near 500°C is observed, which is in disagreement with the phase diagram. The investigations by qualitative dynamical differential calorimetry (DDC) support this conclusion. A proposal for possible corrections in the phase diagram in the temperature interval 493-527°C is given, according to which the γ-phase is located in the temperature interval 500-527°C; its eutectoid transformation takes place at 500°C. Peritectoid transformation of the γ-phase, in agreement with previous investigations, takes place at 527°C.

INTRODUCTION

The recently published phase diagram of the Sb-Zn system[1], a part of which is shown in fig. 1, is based on the diagram given before[2] and the investigations of Vuillard and

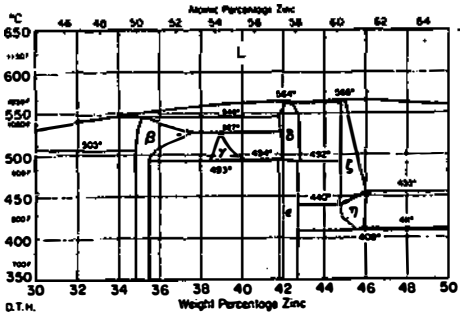

Fig. 1. A part of the phase diagram of the Sb-Zn system of alloys.

Piton[3]. Recent DTA-investigations[3] have located a new phase γ in the temperature interval 493-527°C. This has been the only investigation concerned with this phase.

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The present investigation has been undertaken in order to examine the behaviour of alloys in that temperature interval. For that purpose, measurements of homogenized Sb-Zn alloys in the composition range 36-42 wt.% Zn were taken by the methods of thermal-dilatometry and qualitative dynamical differential calorimetry (DDC).

EXPERIMENTAL PROCEDURE

The specimens were prepared by melting in evacuated pyrex tubes. They were homogenized for 380 hours at 380°C.

Dilatometric and DDC-measurements were taken, using the "Netzsch" high-temperature electronic dilatometer type 402E and DTA-aparature type 404.A heating rate of 5°C/min was used for the dilatometric measurements, while the DDC-measurements were performed at a heating rate of 2°C/min. All measurements were taken in an inert-argon atmosphere.

EXPERIMENTAL RESULTS AND DISCUSSION

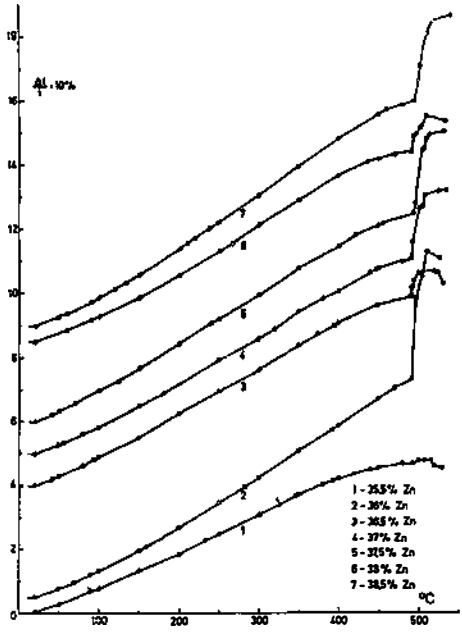

Fig. 2. Relative dilatation vs temperature for alloys of compositions 35,5-38,5 wt.% Zn

The temperature dependence of the relative dilatation $\Delta l/l$ for the alloys investigated is plotted in fig. 2 and fig. 3. A common scale for the $\Delta l/l$ axis is used and the zero of the scale has to be shifted to the horizontal line in the beginning of each diagram. The legend shows the compositions of the alloys in wt.% Zn.

From the diagrams the following behaviour of relative dilatation $\Delta l/l$ can be observed:

- continuous increase in $\Delta l/l$ up to 493°C in alloys of compositions less than 41,72 wt.% Zn, and up to 409-412°C in alloys of com-

positions over 41,72 wt.% Zn;

- an abrupt increase in $\Delta l/l$ at 493°C in all alloys, which, according to the phase diagram (fig. 1), can be related to the transformations at 493°C and 492°C. A maximal increase in $\Delta l/l$ is observed for the alloy of 40 wt.% Zn;

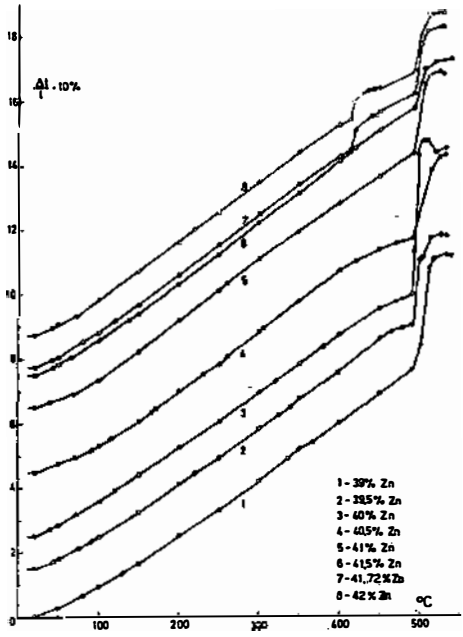

Fig. 3. Relative dilatation vs temperature for alloys of compositions 39-42 wt.% Zn.

- another abrupt change in $\Delta l/l$ near 500°C is observed in the alloys of compositions between 36 and 40 wt.% Zn, which cannot be related to the phase diagram. The alloy of 39 wt.% Zn is characterized by a maximal increase in $\Delta l/l$ between 502°C and 513°C;

- changes in $\Delta l/l$ at 409-412°C and at 440°C in alloys 41,72 wt.% Zn and 42 wt.% Zn, which correspond to the eutectoid transformations at 409°C and 440°C.

The investigations of alloys by DDC show that these changes in $\Delta l/l$ are followed by observable heat absorption effects during the heating of alloys.

The temperatures at which the above-mentioned abrupt changes in $\Delta l/l$ begin are marked by rings on the phase diagram and shown in fig. 4 a). For comparison, the results of DDC-measurements are shown in fig. 4 b).

The abrupt changes in $\Delta l/l$ in alloys of compositions between 36 wt.% Zn and 40 wt.% Zn appearing near 500°C, as well as the conspicious thermal effects at 500°C on the DDC-grams[4], indicate that in this composition interval a new phase transformation line might be located near 500°C, which could be a eutectoid line of γ-phase. From the fact that a maximal thermal effect at 500°C appears for alloy of composition 39,5 wt.% Zn, we may conclude that this composition may coincide with the eutectoid composition of γ-phase. Since the effects near 500°C

do not appear for the compositions above 40 wt.% Zn, it seems that the homogeneity interval of the δ-phase between the temperatures 527°C and 493°C has to be enlarged towards the lower compositions of zinc.

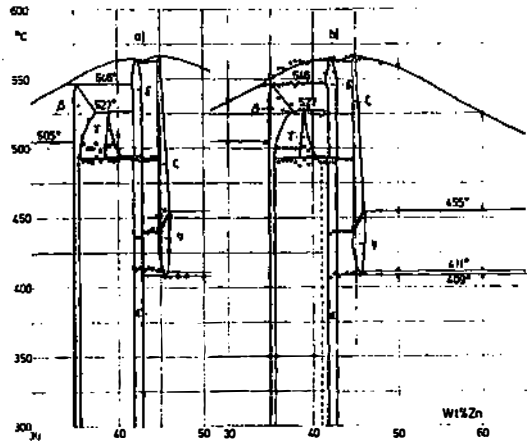

Fig. 4. The temperatures (shown by rings) at which the transformations in alloys begin. a) Dilatometric measurements, b) DDC--measurements.

The maximal increase in $\Delta l/l$ between 493°C and 500°C during the transformation at 493°C for alloy of 40 wt.% Zn, (see fig. 3) may be referred to the effects occurring in alloys of compositions over 40 wt.% Zn. Namely, the occurrence ot eutectoid transformations at 409°C and 440°C in alloys of compositions over 41,72 wt.% Zn indicates that some shift in the ϵ-phase homogeneity interval appears towards the compositions lower than 41,72 wt.% Zn[4]. Such specific behaviour of alloy with 40 wt.% Zn might be ascribed to the eventual coincidence of this alloy with the peritectoid composition of ϵ-phase. The peritectoid transformation takes place at 493°C.

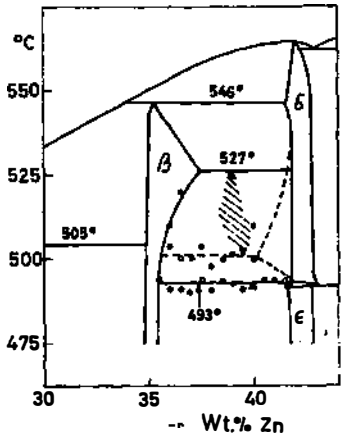

Fig. 5. The proposed corrections in the phase diagram of the Sb-Zn system of alloys.

The possible corrections in the phase diagram of the

Sb-Zn system of alloys, which might be proposed on the basis of the results of the present investigations, are shown in fig. 5, drawn with dotted lines on part of the phase diagram (fig. 1). The rings represent the results of the dilatometric measurements. The dashed area shows the possible location of the γ-phase.

CONCLUSIONS

The results of dilatometric as well as those of DDC--measurements indicate that at 500°C a new phase transformation takes place in the composition range 36-40 wt.% Zn. This transformation is considered to be a eutectoid transformation of the γ-phase and the alloy of 39,5 wt.% Zn as its eutectoid composition.

ACKNOWLEDGMENT

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