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TECHNICAL NOTE

Preliminary Investigation of the System
Titanium - Magnesium

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Very little information is available in the literature concerning the solubility of magnesium in titanium. Aust and Pidgeon[1] report the solubility of titanium in magnesium to be 0.0025% at 650C and 0.015% at 850C. X-ray diffraction studies failed to detect any evidence of solid solubility. Based on the fact that the addition of titanium to magnesium increases the c/a ratio of magnesium, Busk[2] suggested that the Mg-Ti system, like the Mg-Zr, is a peritectic. Eisenreich[3] reported the solubility of titanium in magnesium to be 0.003% at 655C and 0.064% at 760C. Removal of hydrogen from the melt increased the solubility of titanium to 0.115% at 800C. Eisenreich proposes a peritectic type diagram for the high magnesium side of the system. Recent work[4] with Ti-Mg diffusion couples indicate that the solid solubility of titanium in magnesium is extremely small and that there is limited solid solubility of magnesium in titanium.

Experimental work on the Ti-Mg system is complicated by the fact that the boiling point of Mg is considerably below the melting point of Ti. Consequently, the usual alloying

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methods are impractical. Alloying was accomplished in this investigation by sheath-rolling compressed compacts.[5]

The alloys were made from titanium sponge and high purity magnesium. Chemical analysis of the sponge showed 0.04% Mg, <.005% Al, <.001% Cu, .05% Fe, .022% Mn, <.0025% Ni, .007% Si, <.005% V, <.01% Zn.

All heat treating was conducted in a protective atmosphere by encapsulating the specimens in fused silica ampules under a partial pressure of helium. Equilibrium was achieved by holding the specimens at temperature for periods of 24-120 hours. The alloys were hot rolled, cold rolled and annealed prior to solution heat treatment.

Figure 1 shows the constitutional diagram obtained for the Ti-Mg system up to 1.5% titanium. Oxygen was known to be present in the alloys; therefore, it is necessary to consider the alloys as ternary rather than binary and the diagram should be viewed as a plot of a section through the titanium-magnesium oxygen system. Other investigators[6] have shown that the addition of oxygen to titanium stabilize the alpha phase. The data presented in Figure 1 indicates that the addition of magnesium to titanium tends to stabilize the beta phase. Armour Research Foundation[7] has shown that the addition of magnesium to zirconium lowers the alpha transsus and is classified as a beta stabilizer in that system.

Magnesium is soluble in solid titanium to the extent of at least 1.5% in both the alpha and beta phases. No intermetallic compounds or magnesium rich phases were observed either by light microscopy or x-ray diffraction. However, this does not negate the possibility that such phases exist at higher alloy concentrations.

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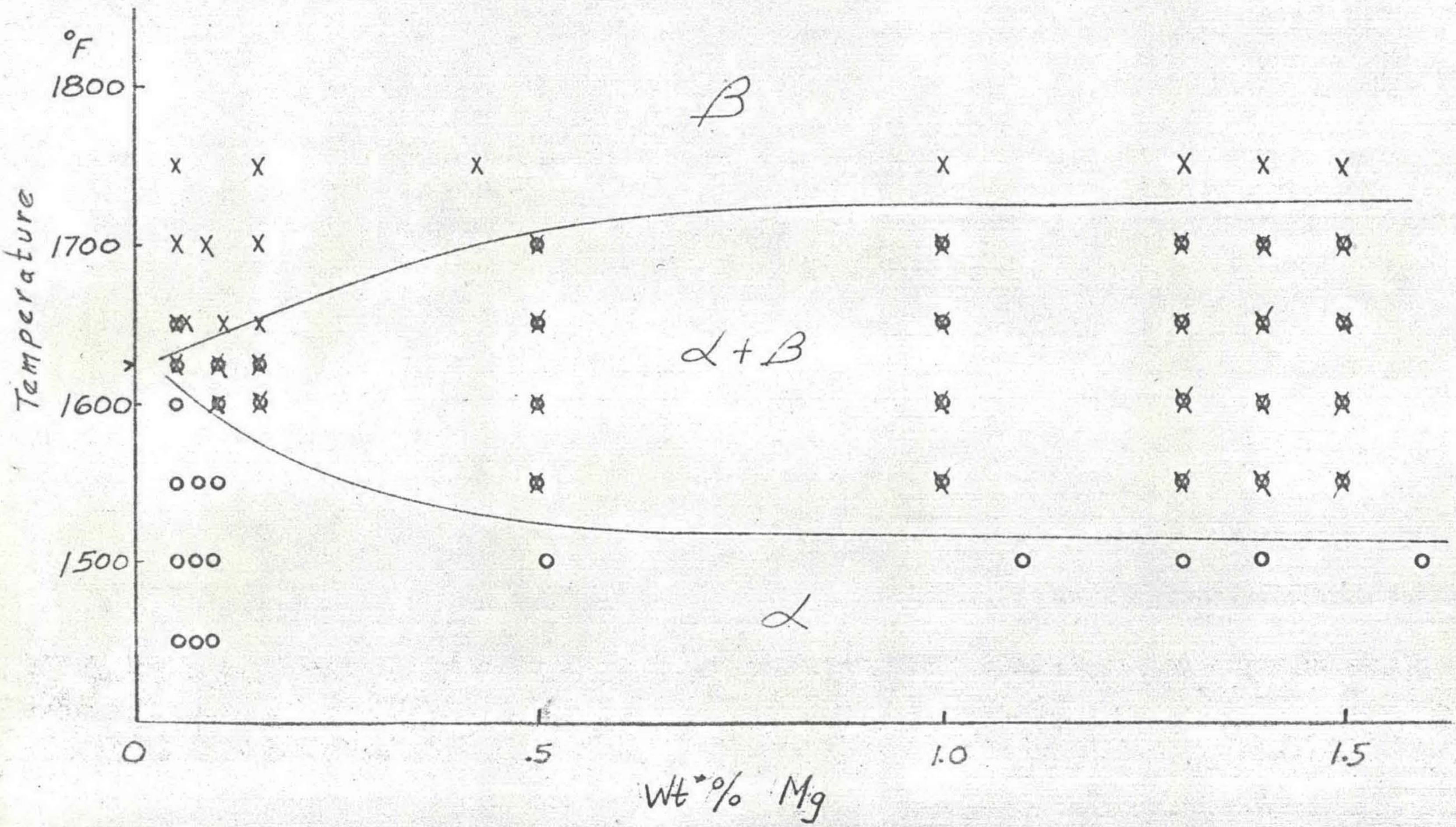

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FIGURE 1

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