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METALLURGY DIVISION

Summary Report for Month

of

June 1945

CLASSIFICATION CANCELLED

DATE 12-15-55

For The Atomic Energy Commission

H. F. Canale

Chief, Declassification Branch *md*

Frank Foote - Acting Division Director

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METALLURGY SECTIONSUMMARYMM 1.1 - Metallurgy of Tuballoy and Its Alloys

Pure Metal: A terminal report is now being written on the high temperature annealing of tuballoy. Because of the great chemical activity of tuballoy at high temperatures, it was found necessary, in order to prevent the formation of a scale on tuballoy wire or powder during heat treatment at 900°C-1000°C, to have the sample protected by the tuballoy "getter." A method of accomplishing this has now been worked out. Evidence from tuballoy wires annealed in various gas atmospheres tended to confirm the existence of TuO and TuN .

Tuballoy-Cerium Alloys: The cerium layers of melts containing overall amounts of cerium corresponding to 5.5% and 28.2% were found to contain 5.4 and 8.6% tuballoy, most of which is present as entrapped particles.

Tuballoy-Columbium Alloys: Two heat treatments of sets of seven different specimens were made at 654°C and 657°C. Metallographic examination showed that the 654°C set had transformed while the 657°C set had not, thus proving that the transformation must occur between these temperatures. However, there is some uncertainty in the calibration of the thermocouple used to measure these temperatures and the transformation can only be reported as 655°C with a possible error of $\pm 4^\circ C$.

The 1/4% columbium sample heated at 657°C was practically single-phase, whereas at 654°C it was definitely two-phase, indicating (with results of a few other treatments of 1/4% samples):

1. that the maximum solubility of columbium in alpha and beta tuballoy is less than 0.3% above 600°C.
2. that the beta phase probably decomposes eutectoidally at a temperature very close to the gamma eutectoid temperature (655°C).

A 4% columbium-tuballoy slug which had been homogenized at 1000°C and water quenched was canned with an unbonded aluminum jacket and artificial defects were made in the center of the can. After two hours there was no swelling, but after 4.5 hours one end of the can swelled sufficiently to jam the cooling water annulus. The corrosion product will be examined to determine whether or not it is the hydride.

Tuballoy-Columbium-Zirconium Alloys: At the end of 32 days of testing in the steam autoclave, the corrosion rates of the 4% Cb-4% Zr, 4% Cb-2% Zr, 2% Cb-4% Zr, and 2% Cb-2% Zr compositions, homogenized and ice brine quenched from 1000°C, were appreciably the same thus indicating that the 2% Cb alloys are as corrosion resistant as those containing 4% Cb.

In order to determine if less than 2% Cb will produce the necessary corrosion resistance, compositions of 1% Cb-1% Zr, 1% Cb-2% Zr, 1% Cb-3% Zr, and 1% Cb-4% Zr, homogenized at 1000°C and quenched in iced brine, were boiled in distilled water for 531 hours. The weight losses of the 1% Cb-2% Zr, 1% Cb-3% Zr and 1% Cb-4% Zr compositions were less than 0.01 mg/cm²/hr. These low columbium compositions are to undergo further corrosion testing in the steam autoclave.

2.1 - Metallurgy of Thorium and Its Alloys

Thorium-Beryllium-Carbon Alloys: A thorium alloy containing 2.11% Be and 0.11% C which had been successfully rolled at 1800°F, resisted corrosion in the steam autoclave for eight days after which it began to pit and lose weight at approximately the same rate as unalloyed thorium. A study of the effect of carbon content and heat treatment on the corrosion resistance of thorium is being planned.

2.1 - Metallurgy of Beryllium and Its Alloys

Beryllium-Columbium Alloys: A 10 wt % columbium alloy was made. It contained considerable amount of a primary compound and an eutectic of small particles of the compound in a matrix of beryllium. Although the cast grains outlined by the eutectic were small, examination under polarized light revealed very large grains. This alloy was somewhat harder than unalloyed beryllium.

Beryllium-Silver Alloys: A 10 wt % silver alloy was made. It consisted of beryllium grains with a network of a low melting material at grain boundaries. This alloy was slightly harder than unalloyed beryllium.

Beryllium-Thorium Alloys: Alloys containing 2.5, 5, and 10 wt % thorium have been made. All contained primary Be-Th compound which is heavier than beryllium and segregates at the bottom of the ingot. There was no evidence of an eutectic.

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CORROSION SECTION

SUMMARY

This section has devoted its efforts during June to termination of its activities and, especially, to preparation of Information Office reports. Attention is directed to two compilations of memoranda which have not been issued through the Information Office. These compilations are entitled "Studies of Corrosion of Aluminum at High Temperatures" and "Studies of Corrosion of Beryllium." They were prepared by Dr. N. Goldowski, and 14 copies have been distributed to interested parties.

The disposition of property used by this section and the transfer or termination of its personnel will be completed by June 30, 1945.

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FABRICATION SECTION

SUMMARY

MM 3.3 - Fabrication of Beryllium and Its Alloys

Iron cans have replaced the copper cans for extrusion billets both at Wolverine Tube Co. and Site B. The iron jacket alloys only slightly with the beryllium and can be mechanically stripped from the extruded rod. Extrusions have been made at 1000° and 1100°C with iron jackets without serious alloying.

Attempts were made to determine if extrusions made with a shear die were superior to those made with 30° angle die in regard to ductility. So far there is no good correlation between the die angle and the ductility of the metal. Bendable rods were made with each type of die. However, it was observed that the 30° angle die required less pressure than the other. Extruded rods have been made that could be cold bent around a 4" diameter post and which could be twisted through more than 360°. Cast extrusion billets of Be, Be +0.65% Zr and Be +2% Al have been made at Site B. The billets were machined and pickled in H₂SO₄ prior to canning. The Be castings were cast both in vacuum and in argon but neither was suitable for extrusion because of many casting defects. The alloy billets contained no cracks but stringers of entrapped foreign material were observed on pickling. Both of these alloys have been successfully extruded at 1000°C.

The ductility of extruded cast billets in no way compares with the ductility of rod made from previously extruded material. Castings which are extruded cannot be bent more than 25-30° while double extruded rods have been bent through 360°. It is felt that cleaner billets are necessary to obtain satisfactory material which can be worked in a normal fashion.

Beryllium tubing with an O.D. of 0.500" and an I.D. of 0.340" has been satisfactorily extruded. The billet used was previously extruded at Wolverine Tube Co. The billet was jacketed with 10 mils of low carbon steel on the outside, inside and bottom. An extrusion temperature of 1050°C and a 30° angle die were used.

Flats 0.500" wide by .125" thick have been extruded successfully through a shear die. Extrusions were made at 1000°C. Rolling of the flats was attempted but so far has not been satisfactory.

Wensel

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