ABSTRACT

Development of the Manufacturing Capabilities
of the Hydrostatic Extrusion Process

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The purpose of the present program is to develop the manufacturing capabilities of the hydrostatic extrusion process. Specific applications being studied are fabrication of wire, tubing, and shapes from relatively difficult-to-work materials such as refractory-metal alloys, high-strength steels and aluminum alloys, titanium alloys, beryllium, and other selected materials.

Investigation of critical process variables for the cold hydrostatic extrusion of 7075-0 aluminum, TZM molybdenum alloy, beryllium, and Ti-6Al-4V titanium alloy was continued during this report period. In addition, two superalloys, A286 (iron-base) and Alloy 718 (nickel-base), were investigated for the first time in this program. With the exception of 7075 aluminum, these materials were also hydrostatically extruded at 400 to 500 F. Further work on the extrusion of beryllium wire is also reported. Important developments in the program are given below:

(1) Beryllium was cold extruded into a 7/8-inch-diameter round at a ratio of 4:1 virtually free of cracks. This is an extremely significant advancement in the cold working of beryllium, particularly since it was achieved using Battelle's double-reduction die concept and without the need of an expensive, fluid counter-pressure system.

(2) TZM molybdenum alloy was also cold extruded at 4:1 without cracks, using the double-reduction die.

(3) Two superalloys, A286 and Alloy 718, were cold extruded without cracking through a die of standard design. The maximum extrusion ratios achievable within the 250,000 psi pressure capacity of the tooling were 5:1 and 3.3:1, respectively.

(4) Fluid pressures to extrude beryllium rounds at 500 F were 1/3 lower than those required at room temperature.

(5) Two samples of 0.020-inch-diameter beryllium wire of ingot origin were reduced 60 percent at 500 F to 0.0124-inch diameter in a single pass by Battelle's process of hydrostatic extrusion-drawing.

(6) In further evaluation of the compound-angle billet nose, 7075-0 aluminum extrusions were produced at a ratio of 60:1 without stick-slip.

(7) 7075-0 aluminum T-sections, 1/4-inch thick, were re-extruded into 1/8-inch and 1/16-inch thick T-sections at ratios of 2:1 and 4:1, respectively.

(8) A sintered, dispersion-hardened aluminum alloy was readily cold extruded at ratios of 10:1 and 20:1 into substantially sound products.

(9) Stick-slip was completely eliminated during both cold and 500 F extrusion of Ti-6Al-4V at a ratio of 4:1. The surface finish was excellent.

(10) Two more specimens of high-quality Ti-6Al-4V tubing, 0.663-inch OD and 0.030-inch wall, were produced in a single-pass reduction of 60 percent at room temperature.

(11) High-density compacts of Ti-6Al-4V powder were made at hydrostatic pressures of 60,000 psi and 225,000 psi for subsequent hydrostatic extrusion.

PUBLICATION REVIEW

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