A LABORATORY MEANS TO PRODUCE TOUGH ALUMINUM SHEET FROM POWDER

O. R. SINGLETON**, D. M. ROYSTER*, & J. R. THOMAS*

*N. A. S. A.
Langley Research Center
Hampton, VA 23665

**Singleton Technology, Inc.
14 Lexington Road
Richmond, VA 23226-1626

ABSTRACT

The rapid solidification of aluminum alloys as powder and the subsequent fabrication processes can be used to develop and tailor alloys to satisfy specific aerospace design requirements. These requirements include high strength and toughness. Laboratory procedures to produce aluminum PM materials are efficient but require evidence that the laboratory methods used can produce a product with superior properties.

This paper describes laboratory equipment and procedures which can be used to produce tough aluminum PM sheet. The processing of a 2124 + 0.9%Zr aluminum alloy powder is used as an example. The fully hardened sheet product is evaluated in terms of properties and microstructure. Key features of the vacuum hot press pressing operation used to consolidate the powder are described.

The 2124 + 0.9%Zr - T8 temper aluminum sheet produced was both strong (460-490 MPa yield strength) and tough (Kahn Tear unit-propagation- energy values over three times those typical for ingot metallurgy 2024-T81). Both the L and LT directions of the sheet were tested. The microstructure was well refined with subgrains of one or two micrometers. Fine dispersoids of Al_3Zr in the precipitate free regions adjacent to boundaries were believed a contributor to the improved toughness.

INTRODUCTION

Advanced aluminum alloys to meet the challenges of aerospace applications can be produced through powder metallurgy[1,2,3](PM). PM and rapid solidification contribute to microstructural control and permit the fabrication of alloys which cannot be produced by ingot metallurgy. Alloy development studies on a small laboratory scale are cost and time effective. However, small scale PM studies have had problems in obtaining effective powder particle bonding[4,5] which is reflected in low transverse ductility and poor toughness[5,6]. For alloy development of aerospace structural materials, toughness is a basic requirement. Hence, any alloy development facility for aerospace materials must show that it has equipment and procedures capable of producing a tough product before it can begin to evaluate and discriminate among candidate alloys.

Previous work[7] at the Langley Research Center (LaRC) of the National Aeronautics and Space Administration showed that it is possible to produce aluminum 2124 series PM sheet on a laboratory scale. In both major directions the LaRC sheet had the strength of commercial, pilot scale sheet of the same alloy but lacked the Kahn Tear toughness of the pilot scale sheet. The powders used in both the LaRC and the pilot study were from the same source. However, the LaRC powders