HIGH TEMPERATURE FATIGUE OF A SUPERALLOY FOR CAST TURBINE WHEEL

J.N. Vincent and L. Rémy
Centre des Matériaux de l'Ecole des Mines de Paris,
ERA CNRS 767, BP 87, 91003 EVRY CEDEX, FRANCE

ABSTRACT

The fatigue behaviour of a cast superalloy, MARM 004, used in cast integral turbine wheel was investigated at 600°C in air. Low cycle fatigue and compact tension specimens were machined in cast wheels, which have a large grain size. The importance of crystallographic cracking in this alloy was emphasized both in low cycle fatigue and in fatigue crack propagation experiments. Comparison with the wrought superalloy IN 718 shows a poorer resistance to crack initiation but a slightly better fatigue crack propagation behaviour of the cast superalloy.

INTRODUCTION

Turbine wheels for gas turbines for high temperature operation are, in the present state of the art, mainly machined from wrought superalloys pancakes with mechanically assembled blades. However if this technique has proved to be very efficient for medium and large turbines, it becomes rather costly for small engines. In the latter case cast integral turbine wheels as produced by precision casting can become a competitive alternative to the traditional solution provided that service performances are not dramatically reduced (1,2).

This paper investigates the case of turbine wheels of cast superalloy MARM 004 which, due to solidification conditions in current foundry practice, exhibits a very large grain size, in the centimetric range, in the bulk part of the disc. Therefore due to the importance of this part in a gas turbine with respect to
Figure 1. As cast turbine wheel in MARM 004. Top: etched mid section showing the dimensions of low cycle fatigue specimens and grain size. Bottom: plan view of the wheel showing the location of CT specimens.