FAILURE MECHANISMS IN FERRITIC-PEARLITIC NODULAR CAST IRON

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Failure of ferritic/pearlitic nodular cast iron is characterized by competing fracture mechanisms. In this study several nodular cast irons having a wide variety of ferrite/pearlite ratio were considered and mechanical properties were studied using tensile tests and impact testing of un-notched and notched bars. In addition to the standard characterization of microstructure, metallographic techniques were applied to failed specimen sections to reveal how microstructural details affected crack path development. SEM observation of the fracture surfaces provided a classification of the main micro mechanisms and their link to local microstructural characteristics.

Key words: *nodular cast iron, ferritic-pearlitic matrix, mechanical strength, impact toughness, fracture micromechanisms*

1. Introduction

The mechanical behavior of nodular cast iron depends on many factors, such as charge composition, chemical composition, inoculation method, size of graphite nodules, proportion of ferrite in the matrix and many others, [1]. The matrix of an as-cast nodular cast iron may range from fully ferritic to fully pearlitic. A heterogeneous ferritic/pearlitic matrix often characterizes a casting. Ferrite is typically a low-yield stress and ductile phase while pearlite is characterized by high strength and brittle behavior. Failure of ferritic/pearlitic nodular cast iron is the result of competing damage mechanisms.

Previous work from the present authors, [2, 3, 4], reported analysis and testing of nodular cast iron, having a wide variety of ferrite/pearlite ratio. Tensile tests and impact testing investigated static and dynamic responses of the microstructures. The transition (ductile-to-brittle) behavior was studied using Charpy V-notched specimens, [4]. Parameters characterizing the fracture surface morphology were determined and correlated to the macroscopic material properties obtained by the mechanical tests. The dependence of the stress-strain behavior from the ferrite/pearlite matrix content was determined using tensile specimens, [3].

The present work briefly reviews results of these earlier studies, [2, 3, 4] then attempts to clarify the role of typical microstructural features on the mechanical properties by investigating fracture profiles and fracture surfaces.

2. Materials and microstructures

Several melts of nodular cast iron having different ferrite/pearlite ratio in the matrix were examined. Production details and resulting chemical composition can be found in [2].

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