International Congress on Science and Engineering
HAMBURG – GERMANY
March 2018

Correlation on inclusion and microstructure characters on fatigue properties of hot rolled CK45 steel

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Abstract

In this research, interaction effects of nonmetallic inclusions and microstructure on the fatigue properties of hot rolled CK45 steel bars were investigated. Inclusions have destructive effects on fatigue properties and should be identified and controlled subsequently. In other hand, microstructure of steel has significant effect on mechanical properties too. So, it is necessary to investigate the effects of both inclusions and microstructure on mechanical properties. Therefore, the samples were prepared from continues casting system. Secondary metallurgy operation was performed to obtain clean CK45 steel bars. Then 70% and 99.4% reduction in cross section by hot rolling operation was applied. Microscopic and fatigue investigations were performed subsequently. It was found that existence of holes consist of inclusion in failure surfaces cause to reduce the effective stress surface and increase the failure contingency. Fatigue results indicated that applying reduction in area in hot rolling causes to improve fatigue property. Point of view microstructure, as the rolled up, structure becomes finer and changes in grain size can't make highlight effect on fatigue resistance. It cause to increase fatigue life by work hardening but not effect on origin of fatigue. It is also distinguished that great binary and trinary inclusions and fine single inclusions cause to crack initiation and crack propagation, respectively. In similar condition, inclusion has more effective influence on fatigue failure than microstructure.

Key words: Inclusion, microstructure, Fatigue, Hot rolling

1. Introduction

The problems of non-metallic inclusions have attracted much attention of manufacturers. Non-metallic inclusions are generally present as oxides or sulfides in steels as a result of deoxidation additions, impurities or corrective material addition in secondary metallurgy [1]. Some of these inclusions and clusters with a size of several tens of μm can considerably reduce the toughness, ductility and fatigue strength [2, 3].