Brittle Crack Arrest Technique of Thick Steel Plate Welds in Container Ship

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ABSTRACT

Experimental study was performed to evaluate the brittle crack arrest toughness value (Kca) and brittle crack arrest method of welded joint for EH40 grade steel. Steel plates with the thickness of 80mm were used and flux cored arc welding (FCAW) and combine welding (EGW+FCAW) process were adopted to prepare the welded joints. Temperature gradient ESSO test was performed to measure the Kca of the welds. Also, constant temperature (-10°C) ESSO test was performed to establish of brittle crack arrest method using real structural specimens. In this study, it was aimed to investigate the effect of joint design and welding consumable on crack arrestability of thick steel plate using EH40 grade shipbuilding steel without block joint shift with 2 kinds of welding process.

KEY WORDS: ESSO test; crack arrest toughness; brittle fracture; brittle crack arrest method

INTRODUCTION

Along with the rapid increase in the size of container ship, the steel plate used for ship hulls has been increased in thickness. The growing capacity of large scale ships such as containers is the cause of increase in the thickness and the strength of steel plates for shipbuilding (Yamaguch, 2005). Recently, shipbuilding companies have tried to use high strength thicker steel plates with yield strength 460MPa class in hatch side coaming of large container ship. Classification society rules (NK, GL, and ABS) require preventing a catastrophic failure along the block joints of the upper flange structure in EH47 rule drafts. Class NK suggest that the brittle crack will be arrested by block joint shifting and using high arrestability steel in hatch side coaming and deck plate with rule draft in guidelines of the application of YP47 steel for hull structures of large container carriers. Also, Class GL suggest that block shit or NDT for brittle crack arrest with rule draft in supplementary rules for application of steel with yield strength of 460N/mm². Class ABS recommend to prevent of brittle crack arrest in block joint using several design concept or block shift with rule draft in higher-strength hull structural thick steel plate in container carrier. A typical example of the strength deck construction of a large container ship is shown in Fig. 1.