Development of Higher Toughness YP47 (460N/mm²) Class Steel Plate for Large Container Ships

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ABSTRACT

An increase in the size of container ships has led to an increase in the thickness of steel materials used, thus causing problems such as making welding work difficult as well as increasing hull weight. In order to alleviate these problems, Nippon Steel Corporation has developed YP47 class steel plates instead of conventional YP40 class steel plates in cooperation with Mitsubishi Heavy Industries, Ltd. and ClassNK, which were then applied to actual ships.

Double integrity for safety was the concept established as a development goal. That is, the goal is to put steel plates into practical application which are hard to initiate brittle cracks, and are capable of arresting brittle cracks even in the event of brittle crack occurrence.

YP47 steel plates have been manufactured on the basis of TMCP utilizing a variety of technologies; for example the technology for dispersing fine oxidation products into steel for enhancing weld toughness, and the technology for rolling in short time period at low temperature for enhancing arrestability.

Large-size container ships, which use or are scheduled to use YP47 steel plate, amount to approximately 50 vessels since the delivery in 2006.

INTRODUCTION

Marine container transport has begun in the 1960s aiming for efficient harbor loading and unloading, realization of land and sea intermodal transport, reduction in transport time and cost, and so on, and has expanded rapidly since then. Now almost all major regular lines in the world employ containerization, thus making it main means for transport supporting the world’s trade and economy.

The most effective means in terms of reduction in environmental burdens and reduction in transport cost is to make the size of ships larger, and the trend toward increasing the size of ships is shown in Fig. 1. The highest strength heavy-thick steel plates ever with 390 N/mm² in yielding point have been used for container ship hulls to maintain their strength, and as shown in Fig. 2, the thickness of plates used continues to increase with an increase in the size of ships. However, there have been problems over the usage of heavy-thick steel plates such as an increase in hull weight and an escalation of welding work cost.

In order to solve these problems, the following development tasks have been addressed: (1) making steel strength higher to refrain vertical structural members from becoming thicker, namely development of high strength and high toughness steel (hereafter referred to as 47 kg high tension steel), (2) development of welding and work execution technologies with high welding capability and high weld toughness which are capable of dealing with higher strength steel and also...