Sea Water Corrosion Resistant Cargo Oil Pipe for Tankers, "JFE-MARINE-COP"[†]

1. Cargo Oil Pipes in Tankers

On-board pipes of tankers, which are called "cargo oil pipes," are used for loading/unloading crude oil and seawater. Accordingly, they are exposed to seawater containing crude oil on both of their inner and outer surfaces, and so generally 400 MPa class steel pipes (STPY400) without coating or Cr-added cast-iron pipes are used. Cargo oil pipes must have corrosion wear resistance, in addition to resistance to seawater corrosion. To meet this demand, JFE Steel developed an anti-seawater corrosion steel pipe (JFE-MARINE-COP, **Photo 1**) which has the weldability equivalent to 400 MPa class





Photo 1 Pipes in a cargo oil tank

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steel pipes and the corrosion resistance and corrosion wear resistance same as cast ion pipes, and has been manufacturing and selling the product since 1998.

This report describes the characteristics and service performance of JFE-MARINE-COP.

2. Characteristics of JFE-MARINE-COP

2.1 Corrosion Resistance and Corrosion Wear Resistance in Seawater

The corrosion rate of general corrosion of steels in artificial seawater at 50° C decreases with increase in Cr content. The corrosion rate of JFE-MARINE-COP, which contains approximately 1% Cr, is about 50% of that of 400 MPa class steels which do not contain Cr (**Fig. 1**).



Fig.1 Corrosion rate (a) and abrasion loss (b) of JFE-MARINE-COP in synthetic sea water in comparison with those of 1% Cr material containing higher C and STPY400 In a corrosion wear test under conditions simulating seawater containing sludge, JFE-MARINE-COP showed corrosion wear resistance about two times better than that of 400 MPa class steels (Fig. 1).

2.2 Weldability and Corrosion Resistance at Circumferential Welding Part

JFE-MARINE-COP which contains less carbon suffers no weld cold cracks at the welded portion in the oblique Y-groove weld cracking tests even without preheating.

JFE Steel has developed various welding consumables for circumferential welding of JFE-MARINE-COP, listed below, through joint research with Kobe Steel, Ltd., and sells them. At the welded portions using these welding consumables, JFE-MARINE-COP demonstrated favorable corrosion resistance and corrosion wear resistance.

LBK-52 for SMAW MGK-52 for GMAW TGSK-52 for TIG

2.3 On-Board Exposure Test

Photo 2 shows the appearance of a cross section of JFE-MARINE-COP after three years of on-board service (the ship "BENETIA") as cargo oil pipe without coating. Both the base material and welded portion of the steel pipe showed very little mass loss caused by general corrosion and local corrosion. The excellent performance is due to the suppression of preferential corrosion at the welding heat affected zone by the effect of the homogeneous microstructure of the base material and the welding heat affected zone combined with the effect of adding Cu, Ni, and Ca.



Photo 2 Cross sections of the MARINE-COP after 3 years of service in a cargo oil tank in BENETIA

3. Manufacturing Experiment

JFE-MARINE-COP is available at strengths equivalent to those of STPY400 and STK490 of JIS G 3457, in an approximate size range from 76.3 to 1 016 mm in outer diameter. Recent annual production rates are between 3 000 and 4 000 t, giving sizes (as UOE steel pipe) from 400 to 750 mm in outer diameter and 9.5 to 23.0 mm in wall thickness.

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