Corrosion-resistant Alloy Clad or Lined Steel Pipe for Submarine Pipeline

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ABSTRACT

CRA (Corrosion-Resistant Alloy) composite pipe for submarine pipeline has both corrosion resistance and high strength, which can effectively solve internal corrosion caused by CO$_2$ or H$_2$S in Offshore Oil and Gas Field. This paper summarizes its classification, manufacture theories, standards and codes for design, material selection, technical difficult and project application. Domestic manufacture and application are described briefly also.

KEY WORDS: Clad pipe; Lined pipe; Submarine pipeline; CO$_2$; H$_2$S.

INTRODUCTION

For the exploitation of oil and gas fields with strong corrosive content, traditional single anti-corrosion technologies and materials such as adding corrosion inhibitors, plastic inner coatings and pure corrosion-resistant alloys are difficult to balance in terms of corrosion resistance reliability and economic indicators, which is difficult to meet the needs of oil and gas field development. In order to reduce the production cost and prolong the service life of the submarine pipeline, the use of corrosion-resistant alloy (CRA) composite pipe is one of the relatively safe and economic ways to solve the corrosion problem of high H$_2$S/CO$_2$ oil and gas fields.

The CRA composite pipe uses a CRA layer or lining inside and the carbon steel backing or base material outside of the pipe. The inner layer or lining has good corrosion resistance, and the base steel pipe has excellent mechanical properties, so that the CRA composite pipe has both corrosion resistance and high strength, which improves the safety level of the pipeline and extends the service life of the pipeline (Zhou et al. 2011). As the consumption of CRA materials is reduced, the cost of the pipe is only 1/5 to 1/2 of that of pure corrosion-resistant alloy.

CRA COMPOSITE PIPE

Classification of CRA Composite Pipe

CRA composite pipe can be divided into CRA lined pipe and CRA clad pipe according to the manufacturing process (Wei et al. 2016). See Fig. 1 and Fig. 2 for its basic structure and cross section details.

![Figure 1. Basic Structure of CRA Lined or Clad Pipe](image1)

![Figure 2. Cross Section of CRA Lined or Clad Pipe](image2)

Lined pipe consists of a carbon steel pipe meeting the requirements of API 5L PSL 2 with an internal CRA liner. The CRA liner is affixed or tightly fitted to the external pipe full length by expansion, compression cold forming, or some other means. The CRA liner may be a tube or pipe inserted into a steel pipe, a plate or sheet rolled into a cylinder by expanding the liner and/or shrinking the pipe, or by some other applicable processes. Lined pipe may be either seamless or welded. Seamless lined pipe consists of an outer seamless pipe made to the requirements of API 5L PSL 2. Welded lined pipe consists of an outer welded pipe made to the requirements of API 5L PSL 2. The liner may be either seamless or welded manufactured to the requirements of appropriate industry standard. Alternatively, weld lined pipe may be made by co-rolling a sandwich of a carbon steel plate and a CRA plate.