

# SUPERMARTENSITIC 13 %Cr LARGE DIAMETER SEAMLESS PIPES: MECHANICAL CORROSION AND WELDABILITY PROPERTIES

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**Abstract** - The demand for weldable 13%Cr pipes with outside diameter such as 18", 20" and 24" has increased greatly. Considering such a requirement, Dalmine and NKK have developed a new production route for OD 20" pipes. Girth welded joints (GTAW) were produced. The mechanical properties of both base material and welded joints meet the target requirements.

Corrosion qualification was aimed to determine the Sulfide Stress Cracking (SSC) resistance in slightly sour oil wells. Influence of chloride content (NaCl 5÷25%), H<sub>2</sub>S partial pressure (1÷10 kPa) and pH (3.5÷5), was assessed. CO<sub>2</sub> corrosion resistance was verified with static exposure tests at medium/high pressure of CO<sub>2</sub>, high chloride (25% NaCl) and temperature up to 150°C.

**Keywords** – 13%Cr steels, flowline, Gas Tungsten Arc Welding (GTAW), toughness, Sulfide Stress Corrosion (SSC).

## I. INTRODUCTION

In the recent years oil & gas wells have been developed in increasingly severe corrosive environments characterized by high temperature, partial pressure of CO<sub>2</sub> and high concentration of chlorides and in some cases of H<sub>2</sub>S (Nice *et al.*, 1997; Scoppio *et al.*, 1997).

A study by Nose and Asahi (2000) emphasize that flowline and gathering lines, which are used to transport oil and gas before any gas processing is performed and water is removed, should provide the same level of corrosion resistance of OCTG materials.

Possible solutions, as indicated by Amaya *et al.*, (1999) and Ogawa *et al.*, (1999), are the use of inhibitors or CRA

duplex steels. These solutions are expensive. The oil companies (Kermani *et al.*, 1995) have been looking for cheaper materials with satisfactory mechanical properties and corrosion resistance.

For these reasons low C martensitic stainless steels have been developed by steel manufacturers (Miyata *et al.*, 1997) and recently started to be used in fields, as flowlines as reported by Rogne *et al.*, 2000.

Satisfactory welding process have been developed by Woollin *et al.*, 1999; Gooch *et al.*, 2000; Rogne *et al.*, 1997.

The demand of weldable 13% Cr linepipe has increased rapidly. Seamless pipes seem to be a cost effective option, compared with longitudinally welded pipes, when high wall thickness is required.

Seamless pipe are typically available in outer diameter (OD) range up to 16" and wall thickness (WT) above 5 mm. Moreover, there is also an increasing demand of 13Cr weldable pipes for larger outer diameter such as 18", 20" and 24".

Considering such requirements, NKK Corporation and Dalmine SpA have developed together a production route for seamless pipes in 13 %Cr of OD larger than 16". Sample pipes with 20" OD were manufactured and weldability tests were carried out.

In this paper, the results of the production and the tests carried out to verify the mechanical and corrosion properties of base material and of welded joints are discussed.

## II. PIPES PRODUCTION & CHARACTERISATION II.1 Production of pipes

Two different mother pipes 406.4 mm OD x 16.8 mm WT and 406.4 mm OD x 23.5 mm WT, with a typical chemistry of the steel for sour service applications, were manu-