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High-strength Large-diameter Pipe for Long-distance High-pressure Gas Pipelines

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ABSTRACT

The energy scenario has been changing quickly in recent years. International studies forecast that the demand for natural gas will be nearly doubled by 2030, and the ever increasing demand for natural gas will further influence the type of its transportation, both from the strategic and economic points of view. While long-distance pipelines are a safe and economic means of transporting gas from production sites to end users, the distance between sites and end users increases, emphasizing the need for the construction of complex gas-transportation pipeline networks when the use of LNG tankers is impossible or uneconomical. This will make high-pressure natural gas transportation via pipelines increasingly challenging. The use of X80-grade linepipe has already been shown to result in substantial cost savings; this paper presents the results of tests on X80-grade production pipe supplied for onshore and offshore projects. But the economic transport of gas over very long distances requires additional cost cuts, and the use of X100- and/or X120-grade linepipe could be a solution. Thus, this paper addresses the benefits of using high-strength linepipe and the present-day technical limitations on its production. In addition, laboratory and production results regarding high-strength large-diameter pipes are presented to describe the material properties as well as the service behaviour. Girth welding procedures covering mechanised and manual methods have already been developed.

INTRODUCTION

This paper gives an overview of the development of high-strength, low-alloy linepipe grades. Some of the current projects for pipelines of X80 grade and the benefits of using X80 pipe are presented. Also, important aspects of the properties of base material and welds are discussed. The development of material grades up to X100 or X120 represents one of the big challenges and opportunities to come. Special attention is focused on the effect of boron on the mechanical properties of the material grades between X80 and X120. Further, the various aspects of production welds and field weldability are dealt with.

PROJECT COST REDUCTION

Project cost reduction may be a result of the sum of the different benefits that can be derived by using high-strength steels (Gräf and Hillenbrand, 1997), even when the price per tonne of the pipe increases as the material grade increases. The benefits include:

- reduced quantity of steel required
- lower pipe transportation costs
- lower pipelaying costs

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KEY WORDS: High strength, large diameter, high pressure, linepipe, gas pipeline.

The use of X80 linepipe in the construction of the first Ruhrgas X80 pipeline led to a material saving of about 20,000 t, compared with X70 pipes (Fig. 1), through a reduction of the wall thickness from 20.8 mm for X70 to 18.3 mm for X80. This resulted also in a reduction of the pipelaying costs, because of reduced pipe transportation costs and greatly reduced welding costs, as thinner walls meant reduced welding times. The use of materials with still higher strength, such as X100 or X120, could lead to further material savings, as Fig. 1 further illustrates.

On the other hand, it becomes clear from Fig. 2 that the reduction in the manufacturing cost per tonne of the pipe at a given transport capacity of a pipeline is enhanced not just by the increase in the material grade of the steel, but also by the

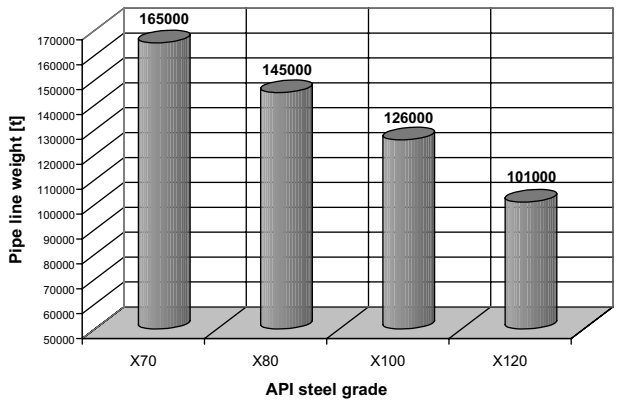

Fig. 1 Possible material savings through use of high-strength material