



## Short Communication

## Research on mathematical model of thermal deformation resistance of X80 pipeline steel

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## ABSTRACT

In this paper, the high-temperature deformation resistance of X80 pipeline steel under different hot deformation conditions was studied through the hot compression test on the Gleeble-3500 thermal/mechanics simulation test machine. The relationship among the deformation temperature, the deformation rate, the deformation degree and the deformation resistance was determined. The mathematical model of the deformation resistance for X80 pipeline steel was established finally and had been proved by the regression analysis to have perfect matching precision.

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## 1. Introduction

With the economic development, people's consumption of natural gas increases day by day and the pressure of transportation of natural gas continue to increase, in order to improve the transport efficiency, the pipeline steel also develops to high strength and high toughness correspondingly [1]. The use of high-performance pipeline steel ensures the safety of high-pressure natural gas transport, which makes the pipeline construction cost reduce significantly, and also makes the economic benefits of pipeline operating better. Pipeline steel X80 is a new generation of acicular ferrite pipeline steel developing from the 1980s in the 20th century. Pipeline steel X80 uses Thermo Mechanical Control Process (TMCP) for production. Mo is the main part of added alloying elements, and a small amount of Nb, V, Ti and other elements are also added [2,3]. In recent years, the development of pipeline steel is rapid. R&D and engineering applications of high-strength pipeline steel have also made a series of major breakthrough in China; many scholars have made the research on the microstructure and performance of pipeline steel X80 under different process conditions [4–6]. And some scholars have made the research on the influence of adding different micro-alloying elements on the microstructure and performance of pipeline steel X80 [2,7–9]; some scholars have studied the welding performance and corrosion resistance of pipeline steel X80 [9–11]; Ming-Chun Zhao and others made the research on the rolling temperature and cooling speed of pipeline steel, and its influence on the microstructure

property of pipeline steel [12]. Niu Jing and others made the research on the tempering microstructure and mechanical properties of pipeline steel X80 [13] but for now only little research on the hot deformation of pipeline steel X80 has been made in China. The precision of hot deformation resistance mathematical model needs to be further improved, thus, further research on hot deformation behavior of X80 pipeline steel is extremely urgent [14,15]. In this paper, the research on the influence of different deformation conditions on hot deformation resistance of X80 pipeline steel was made through thermal simulation experiment. I hope it can provide the actual production application of pipeline steel X80 with some references.

## 2. Experimental materials and measures

The experimental equipment used in the experiment, the Gleeble-3500 thermal simulation machine, is developed by DSI in the United States. This machine is resistance-heating type full-simulation device which can precisely control the parameters such as the temperature, the stress and the strain simultaneously. It consists of the heating system, the augmentation systems and the computer systems.

## 2.1. Experiment materials

The materials used in the experiment are continuous casting billets of X80 pipeline steel produced by some steelworks and the chemical compositions (mass fraction, %) are listed in Table 1. According to the experiment requirements, the experimental materials were cut and machined into totally 63 pieces of cylindrical specimens of 10 mm × 15 mm.

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