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# Cold deformation effect on the microstructures and mechanical properties of AISI 301LN and 316L stainless steels

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ABSTRACT

As austenitic stainless steels have an adequate combination of mechanical resistance, conformability and resistance to corrosion they are used in a wide variety of industries, such as the food, transport, nuclear and petrochemical industries. Among these austenitic steels, the AISI 301LN and 316L steels have attracted prominent attention due to their excellent mechanical resistance. In this paper a microstructural characterization of AISI 301LN and 316L steels was made using various techniques such as metallography, optical microscopy, scanning electronic microscopy and atomic force microscopy, in order to analyze the cold deformation effect. Also, the microstructural changes were correlated with the alterations of mechanical properties of the materials under study. One of the numerous uses of AISI 301LN and 316L steels is in the structure of wagons for metropolitan surface trains. For this type of application it is imperative to know their microstructural behavior when subjected to cold deformation and correlate it with their mechanical properties and resistance to corrosion. Microstructural analysis showed that cold deformation causes significant microstructural modifications in these steels, mainly hardening. This modification increases the mechanical resistance of the materials appropriately for their foreseen application. Nonetheless, the materials become susceptible to pitting corrosion.



## 1. Introduction

Stainless steels first appeared when scientists were trying to develop a state of passivity for ferrous alloys; a state that would not visibly show any oxidization, as was initially produced by Faraday [1]. Harry Bearley's experiment in 1912, which was the addition of 12.5% Cr (chromium) to Fe (iron), initiated commercial production of stainless steels [2]. This material had a martensitic microstructural matrix. Later, following the works of Guillet (France) and Giesen (Germany), Monnartz developed the Fe–Cr–Ni (iron–chromium–nickel) steels in Essen (Germany), giving origin to stainless steels of the austenitic matrix, universally known as 18% Cr–8% Ni [3].

There are five major classes of stainless steels [3]: ferritic, martensitic, duplex, hardened by precipitation, and austenitic, the latter being the focus of this work.

The application of austenitic stainless steels in the food, petrochemical and nuclear industries is due to their combination of good conformability, mechanical resistance and resistance to corrosion. Specifically, steel 301, according to the American Iron and Steel classification (AISI), is widely employed in the making of kitchen sinks and train wagon structures for underground or surface metropolitan trains. The highest level of mechanical resistance of this 301 steel is in the AISI3xx steel family; however, it does not show such a satisfactory level in terms of corrosion [4].

As steel 301 is mechanically unstable, deformation induces extensive martensitic transformation, whose crystalline structure may be compact hexagonal (CH), usually known as martensite ε

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