UNIVERSITY OF ŽILINA
Faculty of Mechanical Engineering
Department of Materials Engineering

SEMDOK 2015

20th Jubilee International seminar of Ph.D. students

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VARIATION OF THE NORMAL ANISOTROPY COEFFICIENT OF AUSTENITIC STAINLESS STEELS AT ELEVATED TEMPERATURES

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Abstract

The paper presents an investigation of the anisotropy properties of austenitic steel AISI 304 (X5CrNi18-10) at elevated temperatures. Anisotropy was considered both theoretically and experimentally. The objective of conducting the experiments was to investigate influence of temperature on normal anisotropy, as well as on the material's mechanical properties. The normal anisotropy was monitored by its coefficient, the so-called "r-value". The tests were done on the 0.7 mm thick sheet metal within the temperature range 20 to 700°C.

Keywords: *Normal Anisotropy; Sheet Metal; Stainless Steel; r-value, Elevated Temperatures*

1. Introduction

The normal anisotropy represents unevenness of material properties over its thickness, with respect to properties within the thin sheet plane. It is expressed by the coefficient of normal anisotropy – the r-value, which shows the resistance of the thin sheet against thinning. The value of this coefficient is influenced by the in-plane anisotropy, as well. Certain materials exhibit the best characteristics in the direction of the thin sheet rolling (0°), some in the direction perpendicular to the rolling direction (90°), or even in the direction at certain angle (45°) [1-2]. The low-carbon steel's thin sheet DC 04 has higher r-values in directions at 0° and 90°. On the contrary, the aluminum alloy AlMg4.5Mn0 and austenitic AISI 304 and ferritic stainless steels AISI 430, exhibit maximum of the r-value in the direction of 45° with respect to the rolling direction. Besides investigation of the r-value for steels, some authors [2] were investigating anisotropy properties of aluminum alloys, while in papers [3-4] were investigated influence of thin sheet manufacturing on change of the anisotropy properties of magnesium alloys, both at room and elevated temperatures. Influence of temperature on change of mechanical properties and anisotropy of molybdenum thin sheets was investigated in [5]. Conclusions of all those authors were that temperature does not impose strong influence on the r-value, but that it does strongly affect tensile strength and the yield stress.

2. Theoretical determination of the r-value

Determination of the anisotropy characteristics is of the practical importance when material is tested by the uniaxial tensile test of samples cut-out from the thin sheet's plane in directions at certain angle with respect to the rolling direction (0°, 45° or 90°). The x-axis coincides with the rolling direction; the y-axis is perpendicular to that direction within the sheet's plane, while the z-axis is perpendicular to the sheet's plane, Figure 1 [2].

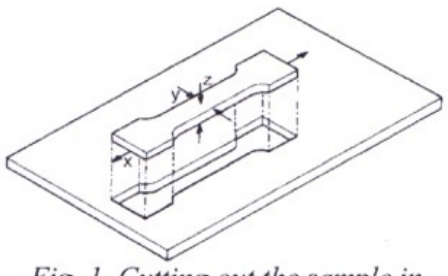

Fig. 1. Cutting out the sample in the thin sheet's rolling direction