11th International Conference on Advanced Materials

ICAM 2009

Rio de Janeiro Brazil
September 20 - 25

Determination of optimal parameters in the hardening and tempering process of SAE 6150 steel as an alternative for the manufacturing of springs

L. C. Pantoja [1], H. E. Jaramillo [1,2,3] J. A. Avila [1,4] and N. A. de Sánchez [1,2,3]*

(1) Grupo Ciencia e Ingeniería de Materiales,
(2)Departamento de Energética y Mecánica, Universidad Autónoma de Occidente, Cali, Colombia nalba@uao.edu.co, hjsuarez@uao.edu.co
(3) Centro de Excelencia en Nuevos Materiales
(4) Joven investigador Colciencias
* Corresponding author.

Abstract –This study shows a comparison of properties between SAE 6150 and SAE 5160 steels. Currently SAE 5160 steel is used in the manufacturing of springs. This comparison allowed analyzing the feasibility of substituting SAE 5160 for SAE 6150. The characterization of the materials was realized through mechanical tests such as: Jominy, tensile, hardness, and Toughness. The steels were characterized in two states: hot rolled and heat treated. Test results revealed that SAE 6150 steel has higher hardenability than SAE 5160 steel in samples up to 40-mm thick.

Regarding the manufacturing of springs, there is a high level of competition and this has led to the quest for continuous improvement in order to achieve greater competitiveness in the market [1]. Additionally, market changes due to new designs that are slowly replacing classical springs, mostly manufactured with steels with diameters ranging from 5.4 to 20 mm. This has led to the proposal of new materials given that – within this range of dimensions– we can obtain the mechanical and structural properties with SAE 5160 steel. However, under certain circumstances that alter the conditions of the product, it is necessary to offer the quality needed, and it is here when the method known as “engineering materials from similar parts” [2] is decided to be applied in order to select SAE 6150 steel, which theoretically has similar mechanical properties as SAE 5160 steel, but adding an element such as vanadium in its chemical composition which allows it to obtain higher hardness depth.

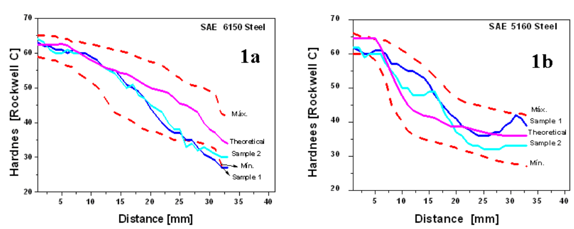

Figure 1: Hardness curves through Jominy test, **a)**6150 steel and **b)** 5160 steel

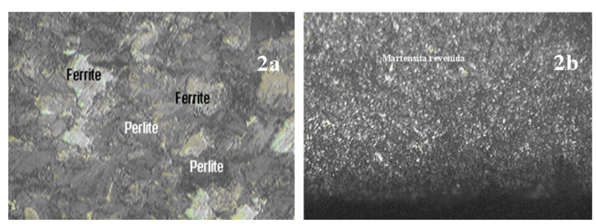

Figure 2: Micrograph of the metallographic structure of steels samples, (Nital 2% at. 50X) **a)** SAE 6150 steel and **b)** SAE 5160 steel

Table 1: Results of tensile tests on laminated state steels

Characteristic	SAE 6150 steel				SAE 5160 steel			
	1	2	3	Average	1	2	3	Average
Elasticity Module, E (GPa)	196	188	229	204	193	202	211	202
Yield Strength, S_y (MPa)	600	720	580	636.6	725	522	557	601.3
Ultimate Strength, S_u (MPa)	1005	1050	1007	1020	1117	1030	1008	1051.6

[1]H. Hernández, A. Viloria, Y. Arango, A. Jiménez, H. Mendoza, J. Cadena. Revista ingeniería e investigación, 56 (2004) 33- 40p.
[2] Kern Roy F. “Steel Selection: A Guide for Improving Performance and Profits”. 1 ed. New York; Ed. John Wiley & Sons, 1979, 445p.